

1. Name of the Medicinal Product

Artemether 40mg plus Lumefantrine 240mg Tablet

2. Qualitative and Quantitative Composition

Each tablet contains:

Artemether 40mg

Lumefantrine 240mg

For Excipients see point 6.1

3. Pharmaceutical Form

Tablet

4. Clinical Particulars

4.1 Therapeutic indications

Artemether/Lumefantrine Tablets are indicated for treatment of acute, uncomplicated malaria infections due to *Plasmodium falciparum* in patients of 5 kg bodyweight and above. Artemether/Lumefantrine Tablets have been shown to be effective in geographical regions where resistance to chloroquine has been reported

4.2 Posology and method of administration

Artemether + Lumefantrine Tablets should be taken with food. Patients with acute malaria are frequently averse to food. Patients should be encouraged to resume normal eating as soon as food can be tolerated since this improves absorption of artemether and lumefantrine.

In the event of vomiting within 1 to 2 hours of administration, a repeat dose should be taken. If the repeat dose is vomited, the patient should be given an alternative antimalarial for treatment.

Adults (Body Weight > 35 Kg)

2 tablets as a single dose at the time of diagnosis, 2 tablet after 8 hrs. and then 2 tablets 12 hourly for next two days (totally 12 tablets/ course).

Dosage in Patients with Hepatic or Renal Impairment No specific dose adjustments are needed for patients with mild or moderate hepatic impairment.

Caution should be exercised when administering combination Tablets in patients with severe hepatic or renal impairment.

4.3 Contraindications

Artemether/Lumefantrine tablet is contraindicated in:

- patients who are hypersensitive to the drug.
- patients with severe malaria according to WHO definition.*
- patients who are taking any drug which is metabolised by the cytochrome enzyme CYP2D6 (e.g. metoprolol, imipramine, amitriptyline, clomipramine).

- patients with a family history of sudden death or of congenital prolongation of the QTc interval on electrocardiograms, or with any other clinical condition known to prolong the QTc interval.
- patients taking drugs that are known to prolong the QTc interval. These drugs include:
 - antiarrhythmics of classes IA and III,
 - neuroleptics, antidepressive agents,
 - certain antibiotics including some agents of the following classes:
 - macrolides, fluoroquinolones, imidazole and triazole antifungal agents,
 - certain non-sedating antihistamines (terfenadine, astemizole),
 - cisapride.
 - flecainide
- patients with a history of symptomatic cardiac arrhythmias or with clinically relevant bradycardia or with congestive cardiac failure accompanied by reduced left ventricle ejection fraction.
- patients with disturbances of electrolyte balance e.g. hypokalemia or hypomagnesemia.
- Co-administration of strong inducers of CYP3A4 such as rifampin, carbamazepine, phenytoin and St. John's wort with Artemether/Lumefantrine Tablets can result in decreased concentrations of artemether and/or lumefantrine and loss of anti-malarial efficacy

(*Presence of one or more of the following clinical or laboratory features:

Clinical manifestation: Prostration; impaired consciousness or unarousable coma; failure to feed; deep breathing, respiratory distress (acidotic breathing); multiple convulsions; circulatory collapse or shock; pulmonary edema (radiological); abnormal bleeding; clinical jaundice; hemoglobinuria

Laboratory test: Severe normocytic anemia; hemoglobuniuria; hypoglycemia; metabolic acidosis; renal impairment; hyperlactatemia; hyperparasitemia)

4.4 Special warnings and precautions for use

Prolongation of the QT Interval: Some antimalarials (e.g., halofantrine, quinine, quinidine) including Artemether/Lumefantrine Tablets have been associated with prolongation of the QT interval on the electrocardiogram.

Artemether/Lumefantrine Tablets should be avoided in patients:

- With congenital prolongation of the QT interval (e.g., long QT syndrome) or any other clinical condition known to prolong the QTc interval such as patients with a history of symptomatic cardiac arrhythmias, with clinically relevant bradycardia or with severe cardiac disease.

- With a family history of congenital prolongation of the QT interval or sudden death.
- With known disturbances of electrolyte balance, e.g., hypokalemia or hypomagnesemia.
- receiving other medications that prolong the QT interval, such as class IA (quinidine, procainamide, disopyramide), or class III (amiodarone, sotalol) antiarrhythmic agents; antipsychotics (pimozide, ziprasidone); antidepressants; certain antibiotics (macrolide antibiotics, fluoroquinolone antibiotics, imidazole, and triazole antifungal agents); certain non-sedating antihistaminics (terfenadine, astemizole), or cisapride.
- Receiving medications that are metabolized by the cytochrome enzyme CYP2D6 which also have cardiac effects (e.g., flecainide, imipramine, amitriptyline, clomipramine).

Use of QT Prolonging Drugs and Other Antimalarials: Halofantrine and Artemether/Lumefantrine Tablets should not be administered within one month of each other due to the long elimination half-life of lumefantrine (3-6 days) and potential additive effects on the QT interval.

Antimalarials should not be given concomitantly with Artemether/Lumefantrine Tablets, unless there is no other treatment option, due to limited safety data.

Drugs that prolong the QT interval, including antimalarials such as quinine and quinidine, should be used cautiously following Artemether/Lumefantrine Tablets, due to the long elimination half-life of lumefantrine (3-6 days) and the potential for additive effects on the QT interval.

If mefloquine is administered immediately prior to Artemether/Lumefantrine Tablets there may be a decreased exposure to lumefantrine, possibly due to a mefloquine-induced decrease in bile production. Therefore, patients should be monitored for decreased efficacy and food consumption should be encouraged while taking Artemether/Lumefantrine Tablets.

Drug Interactions with CYP3A4: When Artemether/Lumefantrine Tablets are co-administered with substrates of CYP3A4 it may result in decreased concentrations of the substrate and potential loss of substrate efficacy. When Artemether/Lumefantrine Tablets are co-administered with an inhibitor of CYP3A4, including grapefruit juice it may result in increased concentrations of artemether and/or lumefantrine and potentiate QT prolongation. When Artemether/Lumefantrine Tablets are co-administered with inducers of CYP3A4 it may result in decreased concentrations of artemether and/or lumefantrine and loss of anti-malarial efficacy.

Drugs that have a mixed effect on CYP3A4, especially Anti-Retroviral drugs, and those that have an effect on the QT interval should be used with caution in patients taking Artemether/Lumefantrine Tablets.

Artemether/Lumefantrine Tablets may reduce the effectiveness of hormonal contraceptives. Therefore, patients using oral, transdermal patch, or other systemic

hormonal contraceptives should be advised to use an additional non-hormonal method of birth control.

Drug Interactions with CYP2D6: Administration of Artemether/Lumefantrine Tablets with drugs that are metabolized by CYP2D6 may significantly increase plasma concentrations of the co-administered drug and increase the risk of adverse effects. Many of the drugs metabolized by CYP2D6 can prolong the QT interval and should not be administered with Artemether/Lumefantrine Tablets due to the potential additive effect on the QT interval (e.g., flecainide, imipramine, amitriptyline, clomipramine).

Recrudescence: Food enhances absorption of artemether and lumefantrine following administration of Artemether/Lumefantrine Tablets. Patients who remain averse to food during treatment should be closely monitored as the risk of recrudescence may be greater.

In the event of recrudescence *P. falciparum* infection after treatment with Artemether/Lumefantrine Tablets, patients should be treated with a different antimalarial drug.

Hepatic and Renal Impairment: Artemether/Lumefantrine Tablets have not been studied for efficacy and safety in patients with severe hepatic and/or renal impairment.

Plasmodium vivax Infection: Artemether/Lumefantrine Tablets have been shown in limited data (43 patients) to be effective in treating the erythrocytic stage of *P. vivax* infection. However, relapsing malaria caused by *P. vivax* requires additional treatment with other antimalarial agents to achieve radical cure i.e., eradicate any hypnozoites forms that may remain dormant in the liver.

Pediatric Use: The safety and effectiveness of Artemether/Lumefantrine Tablets have been established for the treatment of acute, uncomplicated malaria in studies involving pediatric patients weighing 5 kg or more. The safety and efficacy have not been established in pediatric patients who weigh less than 5 kg. Children from non-endemic countries were not included in clinical trials.

Geriatric Use: Clinical studies of Artemether/Lumefantrine Tablets did not include sufficient numbers of subjects aged 65 years and over to determine they respond differently from younger subjects. In general, the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy in elderly patients should be considered when prescribing Artemether/Lumefantrine Tablets.

Hepatic and Renal Impairment: No specific pharmacokinetic studies have been performed in patients with either hepatic or renal impairment. Artemether/Lumefantrine Tablets have not been studied for efficacy and safety in patients with severe hepatic and/or renal impairment. No dosage adjustment is necessary in patients with mild to moderate hepatic and/or renal impairment.

4.5 Interaction with other medicinal products and other forms of interaction

Rifampin: Oral administration of rifampin, a strong CYP3A4 inducer, with Artemether/Lumefantrine Tablets resulted in significant decreases in exposure to artemether, dihydroartemisinin and lumefantrine by 89%, 85% and 68%, respectively, when compared to exposure values after Artemether/Lumefantrine Tablets alone. Concomitant use of strong inducers of CYP3A4 such as rifampin, carbamazepine, phenytoin and St. John's wort is contraindicated with Artemether/Lumefantrine Tablets.

Ketoconazole: Concurrent oral administration of ketoconazole, a potent CYP3A4 inhibitor, with a single dose of Artemether/Lumefantrine Tablets resulted in a moderate increase in exposure to artemether, dihydroartemisinin, and lumefantrine in a study of healthy subjects. No dose adjustment of Artemether/Lumefantrine Tablets is necessary when administered with ketoconazole or other potent CYP3A4 inhibitors. However, due to the potential for increased concentrations of lumefantrine which could lead to QT prolongation, Artemether/Lumefantrine Tablets should be used cautiously with drugs that inhibit CYP3A4.

Anti-Retroviral Drugs: Both artemether and lumefantrine are metabolized by CYP3A4. Anti-retroviral drugs, such as protease inhibitors and non-nucleoside reverse transcriptase inhibitors, are known to have variable patterns of inhibition, induction or competition for CYP3A4. Therefore, the effects of anti-retroviral drugs on the exposure to artemether, DHA, and lumefantrine are also variable. Artemether/Lumefantrine Tablets should be used cautiously in patients on anti-retroviral drugs because decreased artemether, DHA, and/or lumefantrine concentrations may result in a decrease of antimalarial efficacy of Artemether/Lumefantrine Tablets, and increased lumefantrine concentrations may cause QT prolongation.

Prior Use of Mefloquine: Administration of three doses of mefloquine followed 12 hours later by a 6-dose regimen of Artemether/Lumefantrine Tablets in 14 healthy volunteers demonstrated no effect of mefloquine on plasma concentrations of artemether or the artemether/DHA ratio. However, exposure to lumefantrine was reduced, possibly due to lower absorption secondary to a mefloquine-induced decrease in bile production. Patients should be monitored for decreased efficacy and food consumption should be encouraged with administration of Artemether/Lumefantrine Tablets.

Hormonal Contraceptives: *In vitro*, the metabolism of ethinyl estradiol and levonorgestrel was not induced by artemether, DHA, or lumefantrine. However, artemether has been reported to weakly induce, in humans, the activity of CYP2C19, CYP2B6, and CYP3A. Therefore, Artemether/Lumefantrine Tablets may potentially reduce the effectiveness of hormonal contraceptives. Patients using oral, transdermal patch, or other systemic hormonal contraceptives should be advised to use an additional non-hormonal method of birth control.

CYP2D6 Substrates: Lumefantrine inhibits CYP2D6 *in vitro*. Administration of Artemether/Lumefantrine Tablets with drugs that are metabolized by CYP2D6 may

significantly increase plasma concentrations of the co-administered drug and increase the risk of adverse effects. Many of the drugs metabolized by CYP2D6 can prolong the QT interval and should not be administered with Artemether/Lumefantrine Tablets due to the potential additive effect on the QT interval (e.g., flecainide, imipramine, amitriptyline, clomipramine).

Sequential Use of Quinine: A single dose of intravenous quinine (10 mg/kg bodyweight) concurrent with the final dose of a 6-dose regimen of Artemether/Lumefantrine Tablets demonstrated no effect of intravenous quinine on the systemic exposure of DHA or lumefantrine. Quinine exposure was also not altered. Exposure to artemether was decreased. This decrease in artemether exposure is not thought to be clinically significant. However, quinine and other drugs that prolong the QT interval should be used cautiously following treatment with Artemether/Lumefantrine Tablets due to the long elimination half life of lumefantrine and the potential for additive QT effects. ECG monitoring is advised if use of drugs that prolong the QT interval is medically required.

Interaction with Drugs that are Known to Prolong the QT Interval: Artemether/Lumefantrine Tablets is to be used with caution when co-administered with drugs that may cause prolonged QT interval such as antiarrhythmics of classes IA and III, neuroleptics and antidepressant agents, certain antibiotics including some agents of the following classes: macrolides, fluoroquinolones, imidazole, and triazole antifungal agents.

4.6 Pregnancy and lactation

Pregnancy: Category C

Safety data from an observational pregnancy study of approximately 500 pregnant women who were exposed to Artemether/Lumefantrine Tablets (including a third of patients who were exposed in the first trimester), and published data of over 1000 pregnant patients who were exposed to artemisinin derivatives, did not show an increase in adverse pregnancy outcomes or teratogenic effects over background rate.

The efficacy of Artemether/Lumefantrine Tablets in the treatment of acute, uncomplicated malaria in pregnant women has not been established.

Artemether/Lumefantrine Tablets should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Lactation

It is not known whether artemether or lumefantrine is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when Artemether/Lumefantrine Tablets are administered to a nursing woman. Animal data suggest both artemether and lumefantrine are excreted into breast milk. The benefits of breastfeeding to mother and infant should be weighed against potential risk from infant exposure to artemether and lumefantrine through breast milk.

4.7 Effects on ability to drive and use machines

Patients receiving artemether and lumefantrine should be warned that dizziness or fatigue/asthenia may occur in which case they should not drive or use machines

4.8 Undesirable effects

Adverse reactions are ranked under headings of frequency: Very common ($\geq 1/10$), Common ($\geq 1/100$ to $< 1/10$), Uncommon ($\geq 1/1,000$ to $< 1/100$), Rare ($\geq 1/10,000$ to $< 1/1,000$), Very rare ($< 1/10,000$) & Not known (cannot be estimated from available data).

	Adults and adolescents above 12 years of age	Infants and children of 12 years of age and below (incidence estimates)
Immune system disorders		
Hypersensitivity	Not known	Rare
Metabolism and nutrition disorders		
Decreased appetite	Very common	Very common
Psychiatric disorders		
Sleep disorders	Very common	Common
Insomnia	Common	Uncommon
Nervous system disorders		
Headache	Very common	Very common
Dizziness	Very common	Common
Paraesthesia	Common	--
Ataxia, hypoaesthesia	Uncommon	--
Somnolence	Uncommon	Uncommon
Clonus	Common	Uncommon
Cardiac disorders		
Palpitations	Very common	Common
Electrocardiogram QT prolonged	Common	Common
Respiratory, thoracic and mediastinal disorders		
Cough	Common	Very common
Gastrointestinal disorders		
Vomiting	Very common	Very common
Abdominal pain	Very common	Very common
Nausea	Very common	Common
Diarrhoea	Common	Common
Hepatobiliary disorders		
Liver function tests increased	Uncommon	Common
Skin and subcutaneous tissue disorders		
Rash	Common	Common
Pruritus	Common	Uncommon
Urticaria	Uncommon	Uncommon
Angioedema*	Not known	Not known
Musculoskeletal and connective tissue disorders		

Arthralgia	Very common	Common
Myalgia	Very common	Common
General disorders and administration site conditions		
Asthenia	Very common	Common
Fatigue	Very common	Common
Gait disturbance	Common	--

*: These adverse reactions were reported during post-marketing experience. Because these spontaneously reported events are from a population of uncertain size, it is difficult to estimate their frequency.

4.9 Overdose:

There is no information on overdoses of Artemether/Lumefantrine Tablets higher than the doses recommended for treatment.

In cases of suspected overdosage, symptomatic and supportive therapy, which would include ECG and blood electrolyte monitoring, should be given as appropriate.

5. Pharmacological Properties

5.1 Pharmacodynamic properties

Pharmacotherapeutic group : Antimalarial

ATC Code : P01BF01

Artemether/Lumefantrine Tablets, a fixed ratio of 1:6 parts of artemether and lumefantrine, respectively, is an antimalarial agent. Artemether is rapidly metabolized into an active metabolite dihydroartemisinin (DHA). The anti-malarial activity of artemether and DHA has been attributed to endoperoxide moiety. The exact mechanism by which lumefantrine, exerts its anti-malarial effect is not well defined. Available data suggest lumefantrine inhibits the formation of [3-hematin by forming a complex with hemin. Both artemether and lumefantrine were shown to inhibit nucleic acid and protein synthesis. Artemether and lumefantrine are active against the erythrocytic stages of *Plasmodium falciparum*.

5.2 Pharmacokinetic properties

Absorption

Artemether is absorbed fairly rapidly and dihydroartemisinin, the active metabolite of artemether, appears rapidly in the systemic circulation with peak plasma concentrations of both compounds reached about 2 hours after dosing. Mean C_{max} and AUC values of artemether ranged between 60.0-104 ng/mL and 146-338 ng·h/mL, respectively, in fed healthy adults after a single dose of Artemether + Lumefantrine Tablet, 80 mg artemether/480 mg lumefantrine. Mean C_{max} and AUC values of dihydroartemisinin ranged between 49.7-104 ng/mL and 169-308 ng·h/mL, respectively. Absorption of lumefantrine, a highly lipophilic compound, starts after a lag-time of up to 2 hours, with

peak plasma concentration (mean between 5.10-9.80 µg/mL) about 6-8 hours after dosing. Mean AUC values of lumefantrine ranged between 108 and 243 µg·h/mL. Food enhances the absorption of both artemether and lumefantrine: in healthy volunteers the relative bioavailability of artemether was increased more than two-fold, and that of lumefantrine sixteen-fold compared with fasted conditions when Artemether + Lumefantrine Tablet was taken after a high-fat meal.

Food has also been shown to increase the absorption of lumefantrine in patients with malaria, although to a lesser extent (approximately two-fold), most probably due to the lower fat content of the food ingested by acutely ill patients. The food interaction data indicate that absorption of lumefantrine under fasted conditions is very poor (assuming 100% absorption after a high-fat meal, the amount absorbed under fasted conditions would be <10% of the dose). Patients should therefore be encouraged to take the medication with a normal diet as soon as food can be tolerated.

Distribution

Artemether and lumefantrine are both highly bound to human serum proteins *in vitro* (95.4% and 99.7%, respectively). Dihydroartemisinin is also bound to human serum proteins (47% to 76%). Protein binding to human plasma proteins is linear.

Biotransformation

In human liver microsomes and recombinant CYP450 enzymes, the metabolism of artemether was catalyzed predominantly by CYP3A4/5. Dihydroartemisinin (DHA) is an active metabolite of artemether. The metabolism of artemether was also catalyzed to a lesser extent by CYP2B6, CYP2C9 and CYP2C19. *In vitro* studies with artemether at therapeutic concentrations revealed no significant inhibition of the metabolic activities of CYP1A2, CYP2A6, CYP2C9, CYP2C19, CYP2D6, CYP2E1, CYP3A4/5, and CYP4A9/11. *In vitro* studies with artemether, DHA, and lumefantrine at therapeutic concentrations revealed no significant induction of the metabolic activities of CYP1A1, CYP1A2, CYP2B6, CYP2C8, CYP2C9, CYP2C19, CYP3A4, or CYP3A5.

During repeated administration of Artemether/ Lumefantrine Tablets, systemic exposure of artemether decreased significantly, while concentrations of DHA increased, although not to a statistically significant degree. The artemether/DHA AUC ratio is 1.2 after a single dose and 0.3 after 6 doses given over 3 days. This suggests that there was induction of enzymes responsible for the metabolism of artemether.

In human liver microsomes and in recombinant CYP450 enzymes, lumefantrine was metabolized mainly by CYP3A4 to desbutyl-lumefantrine. The systemic exposure to the metabolite desbutyl-lumefantrine was less than 1% of the exposure to the parent compound. *In vitro*, lumefantrine significantly inhibits the activity of CYP2D6 at therapeutic plasma concentrations.

Elimination

Artemether and DHA are cleared from plasma with an elimination half-life of about 2 hours. Lumefantrine is eliminated more slowly, with a terminal half-life of 3-6 days in

healthy volunteers and in patients with falciparum malaria. Demographic characteristics such as sex and weight appear to have no clinically relevant effects on the pharmacokinetics of artemether and lumefantrine.

5.3 Preclinical safety data

Carcinogenesis

Carcinogenicity studies were not conducted.

Mutagenesis

No evidence of mutagenicity was detected. The artemether: lumefantrine combination was evaluated using the Salmonella and iisc/zen'cAza/mammalian-microsome mutagenicity test, the gene mutation test with Chinese hamster cells V79, the cytogenetic test on Chinese hamster cells *in vitro*, and the rat micronucleus test, *in vivo*.

Impairment of Fertility

Pregnancy rates were reduced by about one half in female rats dosed for 2 to 4 weeks with the artemether-lumefantrine combination at 1000 mg/kg (about 9 times the clinical dose based on body surface area comparisons). Male rats dosed for 70 days showed increases in abnormal sperm (87 % abnormal) and increased testes weights at 30 mg/kg doses (about one third the clinical doses). Higher doses (about 9 times the clinical dose) resulted in decreased sperm motility and 100 % abnormal sperm cells.

6. Pharmaceutical Particulars

6.1 List of Excipients

Corn Starch, Colloidal Silicon dioxide, Hypermellose, Low substituted Hydroxypropyl cellulose, Sodium starch glycolate, Magensium stearate Microcrystalline Cellulose.

6.2 Incompatibilities

None

6.3 Shelf life

2 years

6.4 Special precautions for storage

Do not store above 30°C, Protect from light

Keep out of the reach and sight of children.

6.5 Nature and contents of container

Blister Pack - Plain 25 micron Aluminium Foil/ 6-8 gsm HSL, (Width – 298 mm) with Clear PVC/PE/PVDC film 250/25/60 gsm (Width -302 mm)

Blister Pack of 10 tablets, such 10 blisters in a box.

6.6 Special Precaution for disposal

No special requirements.

Any unused product or waste material should be disposed of in accordance with local requirements.

7. Supplier

Macleods Pharmaceuticals Ltd.

304, Atlanta Arcade, Marol Church Road,
Andheri (East), Mumbai- 400 059,
India

Phone: +91-22-66762800

Fax: +91-22-2821 6599

E-mail: exports@macleodsphara.com

8. WHO Reference Number (Prequalification Programme)

9. Date of first Prequalification/ last renewal

10. Date of Revision of the Text:

References:

<http://www.rxlist.com/coartem-drug/.htm>

<https://www.medicines.org.uk/emc/medicine/9196>