

## **SUMMARY OF PRODUCT CHARACTERISTICS**

### **1 NAME OF THE MEDICINAL PRODUCT**

Mycophenolate Mofetil 1g/5ml Oral Suspension

### **2 QUALITATIVE AND QUANTITATIVE COMPOSITION**

Each 5ml of oral suspension contains 1g mycophenolate mofetil.

Excipient(s) with known effect:

Sorbitol (E420)	350 mg/5ml
Methyl parahydroxybenzoate (E218)	12.60 mg/5ml
Propyl parahydroxybenzoate (E216)	2.80 mg/5ml
Propylene glycol (E1520)	2.50 mg/5ml
Benzyl alcohol (E1519)	30.50 µg/5ml
Ethanol	50.00 µg/5ml
Benzoic acid (E210)	0.10 mg/5ml
Sodium less than 1 mmol (23mg) per dose	

For the full list of excipients, see section 6.1.

### **3 PHARMACEUTICAL FORM**

Oral suspension

White to off white suspension.

#### **4.1 Therapeutic indications**

Mycophenolate mofetil is indicated in combination with ciclosporin and corticosteroids for the prophylaxis of acute transplant rejection in adult and paediatric (1 to 18 years of age) patients receiving allogeneic renal, cardiac or hepatic transplants.

## **4.2 Posology and method of administration**

Treatment with mycophenolate mofetil should be initiated and maintained by appropriately qualified transplant specialists.

### Posology

#### Adults

##### Renal transplant

Oral mycophenolate mofetil should be initiated within 72 hours following transplantation. The recommended dose in renal transplant patients is 1 g administered twice daily (2 g daily dose), i.e. 5 mL oral suspension twice daily.

##### Cardiac transplant

Oral mycophenolate mofetil should be initiated within 5 days following transplantation. The recommended dose in cardiac transplant patients is 1.5 g administered twice daily (3 g daily dose).

##### Hepatic transplant

IV mycophenolate mofetil should be administered for the first 4 days following hepatic transplant, with oral mycophenolate mofetil initiated as soon after this as it can be tolerated. The recommended oral dose in hepatic transplant patients is 1.5 g administered twice daily (3 g daily dose).

##### Paediatric population (1 to 18 years)

The paediatric dosing information in this section applies to all oral formulations within the range of mycophenolate mofetil products, as appropriate. Different oral formulations should not be substituted without clinical supervision.

The recommended mycophenolate mofetil initial dose for paediatric renal, cardiac and hepatic transplant patients is 600 mg/m<sup>2</sup> (of body surface area (BSA)) administered orally, twice daily (initial total daily dose not to exceed 2 g, or 10 ml of the oral suspension).

The dose and product form should be individualised based on clinical assessment. If the recommended initial dose is well tolerated but does not achieve clinically adequate immunosuppression in paediatric cardiac and hepatic transplant patients, the dose can be increased to 900 mg/m<sup>2</sup> BSA twice daily (maximum total daily dose of 3 g, or 15 ml of the oral suspension). The recommended maintenance dose for paediatric renal transplant patients remains at 600 mg/m<sup>2</sup> twice daily (maximum total daily dose of 2 g or 10 ml of the oral suspension).

The mycophenolate mofetil powder for oral suspension should be used in those patients unable to swallow capsules and tablets and/or with a BSA lower than 1.25 m<sup>2</sup> due to the increased risk of choking. Patients with a BSA of 1.25 to 1.5 m<sup>2</sup> may be prescribed mycophenolate mofetil capsules at a dose of 750 mg twice daily (1.5 g daily dose). Patients with a BSA greater than 1.5 m<sup>2</sup> may be prescribed mycophenolate mofetil capsules or tablets at a dose of 1 g twice daily (2 g daily dose). As some adverse reactions occur with greater frequency in this age group (see section 4.8) compared with adults, temporary dose reduction or interruption may be required; these will need to take into account relevant clinical factors including severity of reaction.

The table below shows, for a range of BSA, the dose (mg) to volume (ml) conversion using the oral dispenser.

**Table 1 Dose (mg) to volume (ml) conversion of suspension (1 g/ 5 ml) using the oral dispenser**

600 mg/m <sup>2</sup> dose level			900 mg/m <sup>2</sup> dose level		
Child's Body Surface Area (m <sup>2</sup> ) <sup>A</sup>	Total dose to be administered twice a day		Child's Body Surface Area (m <sup>2</sup> ) <sup>A</sup>	Total dose to be administered twice a day	
	mg	ml		mg	ml
0.5	300	1.5	0.5	450	2.25
0.58	350	1.75	0.56	500	2.5
0.67	400	2.0	0.61	550	2.75
0.75	450	2.25	0.67	600	3.0
0.83	500	2.5	0.72	650	3.25
0.92	550	2.75	0.78	700	3.5
1.0	600	3.0	0.89	800	4.0
1.08	650	3.25	1.0	900	4.5
1.17	700	3.5	1.11	1000	5.0
1.25	750	3.75	1.22	1100	5.5
1.33	800	4.0	1.33	1200	6.0

The table lists doses and volumes as calculated theoretically for the two dosing regimens. As the oral dispenser has graduations of 0.25 ml only (corresponding to a 50 mg dose increment), the volume in ml has been rounded up to the nearest graduation mark.

<sup>A</sup>based on the Mosteller formula for body surface area (BSA) calculation:

$$BSA (m^2) = \sqrt{(Height (cm) \times Weight (kg))/3600}$$

*Use in special populations*

### *Elderly*

The recommended dose of 1 g administered twice a day for renal transplant patients and 1.5 g twice a day for cardiac or hepatic transplant patients is appropriate for the elderly.

### *Renal impairment*

In renal transplant patients with severe chronic renal impairment (glomerular filtration rate  $< 25 \text{ mL/min/1.73 m}^2$ ), outside the immediate post-transplant period, doses greater than 1 g administered twice a day should be avoided. These patients should also be carefully observed. No dose adjustments are needed in patients experiencing delayed renal graft function post-operatively (see section 5.2). No data are available for cardiac or hepatic transplant patients with severe chronic renal impairment.

### *Severe hepatic impairment*

No dose adjustments are needed for renal transplant patients with severe hepatic parenchymal disease. No data are available for cardiac transplant patients with severe hepatic parenchymal disease.

### *Treatment during rejection episodes*

#### Adults

Mycophenolic acid (MPA) is the active metabolite of mycophenolate mofetil. Renal transplant rejection does not lead to changes in MPA pharmacokinetics; dosage reduction or interruption of mycophenolate mofetil is not required. There is no basis for mycophenolate mofetil dose adjustment following cardiac transplant rejection. No pharmacokinetic data are available during hepatic transplant rejection.

#### Paediatric population

No data are available for treatment of first or refractory rejection in paediatric transplant patients.

### Method of administration

Oral administration.

*Note:* If required, Mycophenolate Mofetil 1g/5ml Oral Suspension can be administered via a nasogastric tube with a minimum size of 8 French (minimum 1.7 mm interior diameter).

Shake well before use.

### *Precautions to be taken before handling or administering the medicinal product.*

Because mycophenolate mofetil has demonstrated teratogenic effects in rats and rabbits, avoid direct contact of the suspension with the skin. If such contact occurs, wash thoroughly with soap and water; rinse eyes with plain water.

For instructions for use of the medicinal product before administration, see section 6.6.

### 4.3 Contraindications

- Mycophenolate mofetil should not be given to patients with hypersensitivity to mycophenolate mofetil, mycophenolic acid or to any of the excipients listed in section 6.1. Hypersensitivity reactions to mycophenolate mofetil have been observed (see section 4.8).
- Mycophenolate mofetil should not be given to women of childbearing potential who are not using highly effective contraception (see section 4.6).
- Mycophenolate mofetil treatment should not be initiated in women of childbearing potential without providing a pregnancy test result to rule out unintended use in pregnancy (see section 4.6).
- Mycophenolate mofetil should not be used in pregnancy unless there is no suitable alternative treatment to prevent transplant rejection (see section 4.6).
- Mycophenolate mofetil should not be given to women who are breastfeeding (see section 4.6).

### 4.4 Special warnings and precautions for use

#### Neoplasms

Patients receiving immunosuppressive regimens involving combinations of medicinal products, including mycophenolate mofetil, are at increased risk of developing lymphomas and other malignancies, particularly of the skin (see section 4.8). The risk appears to be related to the intensity and duration of immunosuppression rather than to the use of any specific agent. As general advice to minimise the risk for skin cancer, exposure to sunlight and UV light should be limited by wearing protective clothing and using a sunscreen with a high protection factor.

#### Infections

Patients treated with immunosuppressants, including mycophenolate mofetil, are at increased risk for opportunistic infections (bacterial, fungal, viral and protozoal), fatal infections and sepsis (see section 4.8). Such infections include latent viral reactivation, such as hepatitis B or hepatitis C reactivation and infections caused by polyomaviruses (BK virus-associated nephropathy, JC virus associated progressive multifocal leukoencephalopathy PML). Cases of hepatitis due to reactivation of hepatitis B or hepatitis C have been reported in carrier patients treated with immunosuppressants. These infections are often related to a high total immunosuppressive burden and may lead to serious or fatal conditions that physicians should consider in the differential diagnosis in immunosuppressed patients with deteriorating renal function or neurological symptoms. Mycophenolic acid has a cytostatic effect on B- and T-

lymphocytes, therefore an increased severity of COVID-19 may occur, and appropriate clinical action should be considered.

There have been reports of hypogammaglobulinaemia in association with recurrent infections in patients receiving mycophenolate mofetil in combination with other immunosuppressants. In some of these cases switching mycophenolate mofetil to an alternative immunosuppressant resulted in serum IgG levels returning to normal. Patients on mycophenolate mofetil who develop recurrent infections should have their serum immunoglobulins measured. In cases of sustained, clinically relevant hypogammaglobulinaemia, appropriate clinical action should be considered taking into account the potent cytostatic effects that mycophenolic acid has on T- and B-lymphocytes.

There have been published reports of bronchiectasis in adults and children who received mycophenolate mofetil in combination with other immunosuppressants. In some of these cases switching mycophenolate mofetil to another immunosuppressant resulted in improvement in respiratory symptoms. The risk of bronchiectasis may be linked to hypogammaglobulinaemia or to a direct effect on the lung. There have also been isolated reports of interstitial lung disease and pulmonary fibrosis, some of which were fatal (see section 4.8). It is recommended that patients who develop persistent pulmonary symptoms, such as cough and dyspnoea, are investigated.

#### Blood and immune system

Patients receiving mycophenolate mofetil should be monitored for neutropenia, which may be related to mycophenolate mofetil itself, concomitant medications, viral infections, or some combination of these causes. Patients taking mycophenolate mofetil should have complete blood counts weekly during the first month, twice monthly for the second and third months of treatment, then monthly through the first year. If neutropenia develops (absolute neutrophil count  $< 1.3 \times 10^3/\mu\text{l}$ ), it may be appropriate to interrupt or discontinue mycophenolate mofetil.

Cases of pure red cell aplasia (PRCA) have been reported in patients treated with mycophenolate mofetil in combination with other immunosuppressants. The mechanism for mycophenolate mofetil induced PRCA is unknown. PRCA may resolve with dose reduction or cessation of mycophenolate mofetil therapy. Changes to mycophenolate mofetil therapy should only be undertaken under appropriate supervision in transplant recipients in order to minimise the risk of graft rejection (see section 4.8).

Patients receiving mycophenolate mofetil should be instructed to report immediately any evidence of infection, unexpected bruising, bleeding or any other manifestation of bone marrow failure.

Patients should be advised, that during treatment with mycophenolate mofetil, vaccinations may be less effective, and the use of live attenuated vaccines should be avoided (see section 4.5). Influenza vaccination may be of value. Prescribers should refer to national guidelines for influenza vaccination.

### Gastro-intestinal

Mycophenolate mofetil has been associated with an increased incidence of digestive system adverse events, including infrequent cases of gastrointestinal tract ulceration, haemorrhage and perforation. Mycophenolate mofetil should be administered with caution in patients with active serious digestive system disease.

Mycophenolate mofetil is an IMPDH (inosine monophosphate dehydrogenase) inhibitor. Therefore, it should be avoided in patients with rare hereditary deficiency of hypoxanthine-guanine phosphoribosyl-transferase (HGPRT) such as Lesch-Nyhan and Kelley-Seegmiller syndrome.

### Interactions

Caution should be exercised when switching combination therapy from regimens containing immunosuppressants, which interfere with MPA enterohepatic recirculation, e.g. ciclosporin, to others devoid of this effect, e.g. tacrolimus, sirolimus, belatacept, or vice versa, as this might result in changes of MPA exposure. Drugs which interfere with MPA's enterohepatic cycle (e.g. cholestyramine, antibiotics) should be used with caution due to their potential to reduce plasma levels and efficacy of mycophenolate mofetil (see also section 4.5).

It is recommended that mycophenolate mofetil should not be administered concomitantly with azathioprine because such concomitant administration has not been studied.

The risk/benefit ratio of mycophenolate mofetil in combination with sirolimus has not been established (see also section 4.5).

### Therapeutic drug monitoring

Therapeutic drug monitoring of MPA may be appropriate when switching combination therapy (e.g. from ciclosporin to tacrolimus or vice versa) or to ensure adequate immunosuppression in patients with high immunological risk (e.g. risk of rejection, treatment with antibiotics, addition or removal of an interacting medication).

## Special populations

### *Paediatric population*

Very limited post-marketing information indicates a higher frequency of the following adverse events in patients under 6 years of age compared to older patients:

- lymphomas and other malignancies, particularly of post-transplant lymphoproliferative disorder in cardiac transplant patients.
- blood and lymphatic system disorders including anaemia and neutropenia in cardiac transplant patients. This applies for children under 6 years of age compared to older patients, and compared to paediatric hepatic/renal transplant recipients.

Patients taking mycophenolate mofetil should have complete blood counts weekly during the first month, twice monthly for the second and third months of treatment, then monthly through the first year. If neutropenia develops, it may be appropriate to interrupt or discontinue mycophenolate mofetil.

- gastrointestinal disorders including diarrhoea and vomiting.

Treatment should be administered with caution in patients with active serious digestive system disease.

### *Elderly population*

Elderly patients may be at an increased risk of adverse events such as certain infections (including cytomegalovirus tissue invasive disease) and possibly gastrointestinal haemorrhage and pulmonary oedema, compared with younger individuals (see section 4.8).

## Teratogenic effects

Mycophenolate is a powerful human teratogen. Spontaneous abortion (rate of 45% to 49%) and congenital malformations (estimated rate of 23% to 27%) have been reported following MMF exposure during pregnancy. Therefore, mycophenolate mofetil is contraindicated in pregnancy unless there are no suitable alternative treatments to prevent transplant rejection. Female patients of childbearing potential should be made aware of the risks and follow the recommendations provided in section 4.6 (e.g. contraceptive methods, pregnancy testing) prior to, during, and after therapy with mycophenolate mofetil. Physicians should ensure that women taking mycophenolate understand the risk of harm to the baby, the need for effective contraception, and the need to immediately consult their physician if there is a possibility of pregnancy.

## Contraception (see section 4.6)

Because of robust clinical evidence showing a high risk of abortion and congenital malformations when mycophenolate mofetil is used in pregnancy, every effort to avoid pregnancy during treatment should be taken. Therefore, women with childbearing potential must use at least one form of reliable contraception (see section 4.3) before starting mycophenolate mofetil therapy, during therapy, and for six weeks after stopping the therapy, unless abstinence

is the chosen method of contraception. Two complementary forms of contraception simultaneously are preferred to minimise the potential for contraceptive failure and unintended pregnancy.

For contraception advice for men see section 4.6.

#### Educational materials

In order to assist patients in avoiding foetal exposure to mycophenolate and to provide additional important safety information, the Marketing Authorisation Holder will provide educational materials to healthcare professionals. The educational materials will reinforce the warnings about the teratogenicity of mycophenolate, provide advice on contraception before therapy is started and guidance on the need for pregnancy testing. Full patient information about the teratogenic risk and the pregnancy prevention measures should be given by the physician to women of childbearing potential and, as appropriate, to male patients.

#### Additional precautions

Patients should not donate blood during therapy or for at least 6 weeks following discontinuation of mycophenolate. Men should not donate semen during therapy or for 90 days following discontinuation of mycophenolate.

#### Excipients warnings

##### **Mycophenolate mofetil contains sorbitol:**

- This medicine contains 350 mg sorbitol (E420) in each 5 ml dose. The additive effect of concomitantly administered products containing sorbitol (or fructose) and dietary intake of sorbitol (or fructose) should be taken into account. The content of sorbitol in medicinal products for oral use may affect the bioavailability of other medicinal products for oral use administered concomitantly. Patients with hereditary fructose intolerance (HFI) should not take/be given this medicinal product.

##### **Mycophenolate mofetil contain methyl parahydroxybenzoate (E218) and propyl parahydroxybenzoate (E216):**

- This medicine contains 12.6 mg methyl parahydroxybenzoate (E218) and 2.8 mg propyl parahydroxybenzoate (E216) in each 5ml dose. May cause allergic reactions (possibly delayed).

##### **Mycophenolate mofetil contains benzyl alcohol:**

- This medicine contains 30.05 µg benzyl alcohol (E1519) in each 5 ml dose. Benzyl alcohol may cause allergic reactions. Increased risk due to accumulation in young children. High volumes should be used with caution and only if necessary, especially in subjects with liver or kidney impairment because of the risk of accumulation and toxicity (metabolic acidosis).

##### **Mycophenolate mofetil contains alcohol:**

- This medicine contains 50.00 µg of alcohol (ethanol) in each 5 ml dose. The amount in 5ml of the medicine is equivalent to less than 1 ml beer or 1 ml wine. The small amount of alcohol in this medicine will not have any noticeable effects.

##### **Mycophenolate mofetil contains benzoic acid:**

- This medicine contains 0.10 mg benzoic acid (E210) in each 5 ml dose. Benzoic acid may increase jaundice (yellowing of the skin and eyes) in newborn babies (up to 4 weeks old). Increase in bilirubinaemia following its displacement from albumin may increase neonatal jaundice which may develop into kernicterus (non-conjugated bilirubin deposits in the brain tissue).

**Mycophenolate mofetil contains sodium:**

- This medicine contains less than 1 mmol (23 mg) sodium per 5 ml dose, that is to say essentially ‘sodium free’.

#### **4.5 Interaction with other medicinal products and other forms of interaction**

##### Aciclovir

Higher aciclovir plasma concentrations were observed when mycophenolate mofetil was administered with aciclovir in comparison to the administration of aciclovir alone. The changes in MPAG (the phenolic glucuronide of MPA) pharmacokinetics (MPAG increased by 8%) were minimal and are not considered clinically significant. Because MPAG plasma concentrations are increased in the presence of renal impairment, as are aciclovir concentrations, the potential exists for mycophenolate mofetil and aciclovir, or its prodrugs, e.g. valaciclovir, to compete for tubular secretion and further increases in concentrations of both substances may occur.

##### Antacids and proton pump inhibitors (PPIs)

Decreased MPA exposure has been observed when antacids, such as magnesium and aluminium hydroxides, and PPIs, including lansoprazole and pantoprazole, were administered with mycophenolate mofetil. When comparing rates of transplant rejection or rates of graft loss between mycophenolate mofetil patients taking PPIs vs. mycophenolate mofetil patients not taking PPIs, no significant differences were seen. These data support extrapolation of this finding to all antacids because the reduction in exposure when mycophenolate mofetil was co-administered with magnesium and aluminium hydroxides is considerably less than when mycophenolate mofetil was co-administered with PPIs.

##### Medicinal products that interfere with enterohepatic recirculation (e.g. cholestyramine, ciclosporin A, antibiotics)

Caution should be used with medicinal products that interfere with enterohepatic recirculation because of their potential to reduce the efficacy of mycophenolate mofetil.

##### Cholestyramine

Following single dose administration of 1.5 g of mycophenolate mofetil to normal healthy subjects pre-treated with 4 g TID of cholestyramine for 4 days, there was a 40% reduction in the AUC of MPA. (see section 4.4, and section 5.2). Caution should be used during concomitant administration because of the potential to reduce efficacy of mycophenolate mofetil.

##### Ciclosporin A

Ciclosporin A (CsA) pharmacokinetics are unaffected by mycophenolate mofetil.

In contrast, if concomitant CsA treatment is stopped, an increase in MPA AUC of around 30% should be expected. CsA interferes with MPA enterohepatic recycling, resulting in reduced MPA exposures by 30 - 50% in renal transplant patients treated with mycophenolate mofetil and CsA compared with patients receiving sirolimus or belatacept and similar doses of mycophenolate mofetil (see also section 4.4). Conversely, changes of MPA exposure should be expected when switching patients from CsA to one of the immunosuppressants which does not interfere with MPA's enterohepatic cycle.

Antibiotics eliminating  $\beta$ -glucuronidase-producing bacteria in the intestine (e.g. aminoglycoside, cephalosporin, fluoroquinolone, and penicillin classes of antibiotics) may interfere with MPAG/MPA enterohepatic recirculation, thus leading to reduced systemic MPA exposure. Information concerning the following antibiotics is available:

*Ciprofloxacin or amoxicillin plus clavulanic acid*

Reductions in pre-dose (trough) MPA concentrations of about 50% have been reported in renal transplant recipients in the days immediately following commencement of oral ciprofloxacin or amoxicillin plus clavulanic acid. This effect tended to diminish with continued antibiotic use and to cease within a few days of antibiotic discontinuation. The change in pre-dose level may not accurately represent changes in overall MPA exposure. Therefore, a change in the dose of mycophenolate mofetil should not normally be necessary in the absence of clinical evidence of graft dysfunction. However, close clinical monitoring should be performed during the combination and shortly after antibiotic treatment.

*Norfloxacin and metronidazole*

In healthy volunteers, no significant interaction was observed when mycophenolate mofetil was concomitantly administered with norfloxacin or metronidazole separately. However, norfloxacin and metronidazole combined reduced the MPA exposure by approximately 30% following a single dose of mycophenolate mofetil.

*Trimethoprim/sulfamethoxazole*

No effect on the bioavailability of MPA was observed.

Medicinal products that affect glucuronidation (e.g. isavuconazole, telmisartan)

Concomitant administration of drugs affecting glucuronidation of MPA may change MPA exposure. Caution is therefore recommended when administering these drugs concomitantly with mycophenolate mofetil.

*Isavuconazole*

An increase of MPA exposure  $AUC_{0-\infty}$  by 35% was observed with concomitant administration of isavuconazole.

### Telmisartan

Concomitant administration of telmisartan and mycophenolate mofetil resulted in an approximately 30% decrease of MPA concentrations. Telmisartan changes MPA's elimination by enhancing PPAR gamma (peroxisome proliferator-activated receptor gamma) expression, which in turn results in an enhanced uridine diphosphate glucuronyltransferase isoform 1A9 (UGT1A9) expression and activity. When comparing rates of transplant rejection, rates of graft loss or adverse event profiles between mycophenolate mofetil patients with and without concomitant telmisartan medication, no clinical consequences of the pharmacokinetic drug-drug interaction were seen.

### Ganciclovir

Based on the results of a single dose administration study of recommended doses of oral mycophenolate and IV ganciclovir and the known effects of renal impairment on the pharmacokinetics of mycophenolate mofetil (see section 4.2) and ganciclovir, it is anticipated that co-administration of these agents (which compete for mechanisms of renal tubular secretion) will result in increases in MPAG and ganciclovir concentration. No substantial alteration of MPA pharmacokinetics is anticipated and mycophenolate mofetil dose adjustment is not required. In patients with renal impairment in whom mycophenolate mofetil and ganciclovir or its prodrugs, e.g. valganciclovir, are co-administered, the dose recommendations for ganciclovir should be observed and patients should be monitored carefully.

### Oral contraceptives

The pharmacokinetics and pharmacodynamics of oral contraceptives were unaffected to a clinically relevant degree by co-administration of mycophenolate mofetil (see also section 5.2).

### Rifampicin

In patients not also taking ciclosporin, concomitant administration of mycophenolate mofetil and rifampicin resulted in a decrease in MPA exposure ( $AUC_{0-12h}$ ) of 18% to 70%. It is recommended to monitor MPA exposure levels and to adjust mycophenolate mofetil doses accordingly to maintain clinical efficacy when rifampicin is administered concomitantly.

### Sevelamer

Decrease in MPA  $C_{max}$  and  $AUC_{0-12h}$  by 30% and 25%, respectively, were observed when mycophenolate mofetil was concomitantly administered with sevelamer without any clinical consequences (i.e. graft rejection). It is recommended, however, to administer mycophenolate mofetil at least one hour before or three hours after sevelamer intake to minimise the impact on the absorption of MPA. There are no data on mycophenolate mofetil with phosphate binders other than sevelamer.

### Tacrolimus

In hepatic transplant patients initiated on mycophenolate mofetil and tacrolimus, the AUC and  $C_{max}$  of MPA, the active metabolite of mycophenolate mofetil, were not significantly affected by co-administration

with tacrolimus. In contrast, there was an increase of approximately 20% in tacrolimus AUC when multiple doses of mycophenolate mofetil (1.5 g BID) were administered to hepatic transplant patients taking tacrolimus. However, in renal transplant patients, tacrolimus concentration did not appear to be altered by mycophenolate mofetil (see also section 4.4).

#### Live vaccines

Live vaccines should not be given to patients with an impaired immune response. The antibody response to other vaccines may be diminished (see also section 4.4).

#### Paediatric population

Interaction studies have only been performed in adults.

#### Potential interaction

Co-administration of probenecid with mycophenolate mofetil in monkeys raises plasma AUC of MPAG by 3-fold. Thus, other substances known to undergo renal tubular secretion may compete with MPAG, and thereby raise plasma concentrations of MPAG or the other substance undergoing tubular secretion.

## **4.6 Fertility, pregnancy and lactation**

#### Women of childbearing potential

Pregnancy whilst taking mycophenolate must be avoided. Therefore, women of childbearing potential must use at least one form of reliable contraception (see section 4.3) before starting mycophenolate mofetil therapy, during therapy, and for six weeks after stopping the therapy, unless abstinence is the chosen method of contraception. Two complementary forms of contraception simultaneously are preferred.

#### Pregnancy

Mycophenolate mofetil is contraindicated during pregnancy unless there is no suitable alternative treatment to prevent transplant rejection. Treatment should not be initiated without providing a negative pregnancy test result to rule out unintended use in pregnancy (see section 4.3).

Female patients of reproductive potential must be made aware of the increased risk of pregnancy loss and congenital malformations at the beginning of the treatment and must be counselled regarding pregnancy prevention and planning.

Before starting mycophenolate mofetil treatment, women of childbearing potential should have two negative serum or urine pregnancy tests with a sensitivity of at least 25 mIU/mL in order to exclude unintended exposure of the embryo to mycophenolate. It is recommended that the second test should be performed 8 - 10 days after the first test. For transplants from deceased donors, if it is not possible to perform two tests 8 - 10 days apart before treatment starts (because of the timing of transplant organ availability), a

pregnancy test must be performed immediately before starting treatment and a further test performed 8 - 10 days later. Pregnancy tests should be repeated as clinically required (e.g. after any gap in contraception is reported). Results of all pregnancy tests should be discussed with the patient. Patients should be instructed to consult their physician immediately should pregnancy occur.

Mycophenolate is a powerful human teratogen, with an increased risk of spontaneous abortions and congenital malformations in case of exposure during pregnancy;

- Spontaneous abortions have been reported in 45 to 49% of pregnant women exposed to mycophenolate mofetil, compared to a reported rate of between 12 and 33% in solid organ transplant patients treated with immunosuppressants other than mycophenolate mofetil.
- Based on literature reports, malformations occurred in 23 to 27% of live births in women exposed to mycophenolate mofetil during pregnancy (compared to 2 to 3 % of live births in the overall population and approximately 4 to 5% of live births in solid organ transplant recipients treated with immunosuppressants other than mycophenolate mofetil).

Congenital malformations, including reports of multiple malformations, have been observed post-marketing in children of patients exposed to mycophenolate mofetil during pregnancy in combination with other immunosuppressants. The following malformations were most frequently reported:

- Abnormalities of the ear (e.g. abnormally formed or absent external ear), external auditory canal atresia (middle ear);
- Facial malformations such as cleft lip, cleft palate, micrognathia and hypertelorism of the orbits;
- Abnormalities of the eye (e.g. coloboma);
- Congenital heart disease such as atrial and ventricular septal defects;
- Malformations of the fingers (e.g. polydactyly, syndactyly);
- Tracheo-oesophageal malformations (e.g. oesophageal atresia);
- Nervous system malformations such as spina bifida;
- Renal abnormalities.

In addition, there have been isolated reports of the following malformations:

- Microphthalmia;
- Congenital choroid plexus cyst;
- Septum pellucidum agenesis;
- Olfactory nerve agenesis.

Studies in animals have shown reproductive toxicity (see section 5.3).

#### Breast-feeding

Limited data shows that mycophenolic acid is excreted in human milk. Because of the potential for serious adverse reactions to mycophenolate mofetil in breast-fed infants, mycophenolate mofetil is contraindicated in nursing mothers (see section 4.3).

### Men

Limited clinical evidence does not indicate an increased risk of malformations or miscarriage following paternal exposure to mycophenolate mofetil.

MPA is a powerful teratogen. It is not known if MPA is present in semen. Calculations based on animal data show that the maximum amount of MPA that could potentially be transferred to woman is so low that it would be unlikely to have an effect. Mycophenolate has been shown to be genotoxic in animal studies at concentrations exceeding the human therapeutic exposures only by small margins such that the risk of genotoxic effects on sperm cells cannot completely be excluded.

Therefore, the following precautionary measures are recommended: sexually active male patients or their female partners are recommended to use reliable contraception during treatment of the male patient and for at least 90 days after cessation of mycophenolate mofetil. Male patients of reproductive potential should be made aware of and discuss with a qualified healthcare professional the potential risks of fathering a child.

### Fertility

Mycophenolate mofetil had no effect on fertility of male rats at oral doses up to 20 mg/kg/day. The systemic exposure at this dose represents 2 – 3 times the clinical exposure at the recommended clinical dose of 2 g/day in renal transplant patients and 1.3 – 2 times the clinical exposure at the recommended clinical dose of 3 g/day in cardiac transplant patients. In a female fertility and reproduction study conducted in rats, oral doses of 4.5 mg/kg/day caused malformations (including anophthalmia, agnathia, and hydrocephaly) in the first generation offspring in the absence of maternal toxicity. The systemic exposure at this dose was approximately 0.5 times the clinical exposure at the recommended clinical dose of 2 g/day for renal transplant patients and approximately 0.3 times the clinical exposure at the recommended clinical dose of 3 g/day for cardiac transplant patients. No effects on fertility or reproductive parameters were evident in the dams or in the subsequent generation.

## **4.7 Effects on ability to drive and use machines**

Mycophenolate mofetil has moderate influence on the ability to drive and use machines.

Mycophenolate mofetil may cause somnolence, confusion, dizziness, tremor or hypotension, and therefore patients are advised to use caution when driving or using machines.

## **4.8 Undesirable effects**

*Summary of safety profile*

Diarrhoea (up to 52.6%), leucopenia (up to 45.8%), bacterial infections (up to 39.9%) and vomiting (up to 39.1%) were among the most common and/or serious adverse drug reactions associated with the administration of mycophenolate mofetil in combination with ciclosporin and corticosteroids. There is evidence of a higher frequency of certain types of infections (see section 4.4).

*Tabulated list of adverse reactions*

The adverse drug reactions (ADRs) from clinical trials and post-marketing experience are listed in Table 1, by MedDRA system organ class (SOC) along with their frequencies. The corresponding frequency category for each adverse drug reaction is based on the following convention: 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  $< 1/1,000$ ) and very rare ( $< 1/10,000$ ). Due to the large differences observed in the frequency of certain ADRs across the different transplant indications, the frequency is presented separately for renal, hepatic and cardiac transplant patients.

**Table 1 Summary of adverse drug reactions occurring in patients treated with mycophenolate mofetil reported from clinical trials and post-marketing experience.**

<b>Adverse drug reaction (MedDRA)</b>	<b>Renal transplant</b>	<b>Hepatic transplant</b>	<b>Cardiac transplant</b>
<b>System Organ Class</b>			
	Frequency	Frequency	Frequency
<b>Infections and infestations</b>			
Bacterial infections	Very Common	Very Common	Very Common
Fungal infections	Common	Very Common	Very Common
Protozoal infections	Uncommon	Uncommon	Uncommon
Viral infections	Very Common	Very Common	Very Common
<b>Neoplasms benign, malignant and unspecified (including cysts and polyps)</b>			
Benign neoplasm of skin	Common	Common	Common
Lymphoma	Uncommon	Uncommon	Uncommon
Lymphoproliferative disorder	Uncommon	Uncommon	Uncommon
Neoplasm	Common	Common	Common
Skin cancer	Common	Uncommon	Common
<b>Blood and lymphatic system disorders</b>			
Anemia	Very Common	Very Common	Very Common
Aplasia pure red cell	Uncommon	Uncommon	Uncommon
Bone marrow failure	Uncommon	Uncommon	Uncommon

<b>Adverse drug reaction (MedDRA) System Organ Class</b>	<b>Renal transplant</b>	<b>Hepatic transplant</b>	<b>Cardiac transplant</b>
Ecchymosis	Common	Common	Very Common
Leukocytosis	Common	Very Common	Very Common
Leucopenia	Very Common	Very Common	Very Common
Pancytopenia	Common	Common	Uncommon
Pseudolymphoma	Uncommon	Uncommon	Common
Thrombocytopenia	Common	Very Common	Very Common
<b>Metabolism and nutrition disorders</b>			
Acidosis	Common	Common	Very Common
Hypercholesterolemia	Very Common	Common	Very Common
Hyperglycemia	Common	Very Common	Very Common
Hyperkalemia	Common	Very Common	Very Common
Hyperlipidemia	Common	Common	Very Common
Hypocalcemia	Common	Very Common	Common
Hypokalemia	Common	Very Common	Very Common
Hypomagnesemia	Common	Very Common	Very Common
Hypophosphatemia	Very Common	Very Common	Common
Hyperuricaemia	Common	Common	Very Common
Gout	Common	Common	Very Common
Weight decreased	Common	Common	Common
<b>Psychiatric disorders</b>			
Confusional state	Common	Very Common	Very Common
Depression	Common	Very Common	Very Common
Insomnia	Common	Very Common	Very Common
Agitation	Uncommon	Common	Very Common
Anxiety	Common	Very Common	Very Common
Thinking abnormal	Uncommon	Common	Common
<b>Nervous system disorders</b>			
Dizziness	Common	Very Common	Very Common
Headache	Very Common	Very Common	Very Common
Hypertonia	Common	Common	Very Common
Paresthesia	Common	Very Common	Very Common
Somnolence	Common	Common	Very Common
Tremor	Common	Very Common	Very Common

<b>Adverse drug reaction (MedDRA) System Organ Class</b>	<b>Renal transplant</b>	<b>Hepatic transplant</b>	<b>Cardiac transplant</b>
Convulsion	Common	Common	Common
Dysgeusia	Uncommon	Uncommon	Common
<b>Cardiac disorders</b>			
Tachycardia	Common	Very Common	Very Common
<b>Vascular disorders</b>			
Hypertension	Very Common	Very Common	Very Common
Hypotension	Common	Very Common	Very Common
Lymphocele	Uncommon	Uncommon	Uncommon
Venous thrombosis	Common	Common	Common
Vasodilatation	Common	Common	Very Common
<b>Respiratory, thoracic and mediastinal disorders</b>			
Bronchiectasis	Uncommon	Uncommon	Uncommon
Cough	Very Common	Very Common	Very Common
Dyspnea	Very Common	Very Common	Very Common
Interstitial lung disease	Uncommon	Very Rare	Very Rare
Pleural effusion	Common	Very Common	Very Common
Pulmonary fibrosis	Very Rare	Uncommon	Uncommon
<b>Gastrointestinal disorders</b>			
Abdominal distension	Common	Very Common	Common
Abdominal pain	Very Common	Very Common	Very Common
Colitis	Common	Common	Common
Constipation	Very Common	Very Common	Very Common
Decreased appetite	Common	Very Common	Very Common
Diarrhea	Very Common	Very Common	Very Common
Dyspepsia	Very Common	Very Common	Very Common
Esophagitis	Common	Common	Common
Eructation	Uncommon	Uncommon	Common
Flatulence	Common	Very Common	Very Common
Gastritis	Common	Common	Common
Gastrointestinal haemorrhage	Common	Common	Common
Gastrointestinal ulcer	Common	Common	Common
Gingival hyperplasia	Common	Common	Common
Ileus	Common	Common	Common

<b>Adverse drug reaction (MedDRA) System Organ Class</b>	<b>Renal transplant</b>	<b>Hepatic transplant</b>	<b>Cardiac transplant</b>
Mouth ulceration	Common	Common	Common
Nausea	Very Common	Very Common	Very Common
Pancreatitis	Uncommon	Common	Uncommon
Stomatitis	Common	Common	Common
Vomiting	Very Common	Very Common	Very Common
<b>Immune system disorders</b>			
Hypersensitivity	Uncommon	Common	Common
Hypogammaglobulinaemia	Uncommon	Very Rare	Very Rare
<b>Hepatobiliary disorders</b>			
Blood alkaline phosphatase increased	Common	Common	Common
Blood lactate dehydrogenase increased	Common	Uncommon	Very Common
Hepatic enzyme increased	Common	Very Common	Very Common
Hepatitis	Common	Very Common	Uncommon
Hyperbilirubinaemia	Common	Very Common	Very Common
Jaundice	Uncommon	Common	Common
<b>Skin and subcutaneous tissue disorders</b>			
Acne	Common	Common	Very Common
Alopecia	Common	Common	Common
Rash	Common	Very Common	Very Common
Skin hypertrophy	Common	Common	Very Common
<b>Musculoskeletal and connective tissue disorders</b>			
Arthralgia	Common	Common	Very Common
Muscular weakness	Common	Common	Very Common
<b>Renal and urinary disorders</b>			
Blood creatinine increased	Common	Very Common	Very Common
Blood urea increased	Uncommon	Very Common	Very Common
Hematuria	Very Common	Common	Common
Renal impairment	Common	Very Common	Very Common
<b>General disorders and administration site conditions</b>			
Asthenia	Very Common	Very Common	Very Common
Chills	Common	Very Common	Very Common
Edema	Very Common	Very Common	Very Common

<b>Adverse drug reaction (MedDRA) System Organ Class</b>	<b>Renal transplant</b>	<b>Hepatic transplant</b>	<b>Cardiac transplant</b>
Hernia	Common	Very Common	Very Common
Malaise	Common	Common	Common
Pain	Common	Very Common	Very Common
Pyrexia	Very Common	Very Common	Very Common
De novo purine synthesis inhibitors associated acute inflammatory syndrome	Uncommon	Uncommon	Uncommon

#### Description of selected adverse reactions

##### Malignancies

Patients receiving immunosuppressive regimens involving combinations of medicinal products, including mycophenolate mofetil, are at increased risk of developing lymphomas and other malignancies, particularly of the skin (see section 4.4). Three-year safety data in renal and cardiac transplant patients did not reveal any unexpected changes in incidence of malignancy compared to the 1-year data. Hepatic transplant patients were followed for at least 1 year, but less than 3 years.

##### Infections

All patients treated with immunosuppressants are at increased risk of bacterial, viral and fungal infections (some of which may lead to a fatal outcome), including those caused by opportunistic agents and latent viral reactivation. The risk increases with total immunosuppressive load (see section 4.4). The most serious infections were sepsis, peritonitis, meningitis, endocarditis, tuberculosis and atypical mycobacterial infection. The most common opportunistic infections in patients receiving mycophenolate mofetil (2 g or 3 g daily) with other immunosuppressants in controlled clinical trials in renal, cardiac and hepatic transplant patients followed for at least 1 year were candida mucocutaneous, CMV viraemia/syndrome and Herpes simplex. The proportion of patients with CMV viraemia/syndrome was 13.5%. Cases of BK virus-associated nephropathy, as well as cases of JC virus-associated progressive multifocal leukoencephalopathy (PML), have been reported in patients treated with immunosuppressants, including mycophenolate mofetil.

##### Blood and lymphatic disorders

Cytopenias, including leucopenia, anemia, thrombocytopenia and pancytopenia, are known risks associated with mycophenolate mofetil and may lead or contribute to the occurrence of infections and haemorrhages (see section 4.4). Agranulocytosis and neutropenia have been reported; therefore, regular monitoring of patients taking mycophenolate mofetil is advised (see section 4.4). There have been reports of aplastic anaemia and bone marrow failure in patients treated with mycophenolate mofetil, some of which have been fatal.

Cases of pure red cell aplasia (PRCA) have been reported in patients treated with mycophenolate mofetil (see section 4.4).

Isolated cases of abnormal neutrophil morphology, including the acquired Pelger-Huet anomaly, have been observed in patients treated with mycophenolate mofetil. These changes are not associated with impaired neutrophil function. These changes may suggest a 'left shift' in the maturity of neutrophils in haematological investigations, which may be mistakenly interpreted as a sign of infection in immunosuppressed patients such as those that receive mycophenolate mofetil.

#### Gastrointestinal disorders

The most serious gastrointestinal disorders were ulceration and hemorrhage which are known risks associated with mycophenolate mofetil. Mouth, esophageal, gastric, duodenal, and intestinal ulcers often complicated by hemorrhage, as well as hematemesis, melena, and hemorrhagic forms of gastritis and colitis were commonly reported during the pivotal clinical trials. The most common gastrointestinal disorders, however, were diarrhoea, nausea and vomiting. Endoscopic investigation of patients with mycophenolate mofetil-related diarrhoea have revealed isolated cases of intestinal villous atrophy (see section 4.4).

#### Hypersensitivity

Hypersensitivity reactions, including angioneurotic oedema and anaphylactic reaction have been reported.

#### Pregnancy, puerperium and perinatal conditions

Cases of spontaneous abortion have been reported in patients exposed to mycophenolate mofetil, mainly in the first trimester, see section 4.6.

#### Congenital disorders

Congenital malformations have been observed post-marketing in children of patients exposed to mycophenolate mofetil in combination with other immunosuppressants, see section 4.6.

#### Respiratory, thoracic and mediastinal disorders

There have been isolated reports of interstitial lung disease and pulmonary fibrosis in patients treated with mycophenolate mofetil in combination with other immunosuppressants, some of which have been fatal. There have also been reports of bronchiectasis in children and adults.

#### Immune system disorders

Hypogammaglobulinaemia has been reported in patients receiving mycophenolate mofetil in combination with other immunosuppressants.

#### General disorders and administration site conditions

Oedema, including peripheral, face and scrotal oedema, was reported very commonly during the pivotal trials. Musculoskeletal pain such as myalgia, and neck and back pain were also very commonly reported.

De novo purine synthesis inhibitors associated acute inflammatory syndrome has been described from post-marketing experience as a paradoxical proinflammatory reaction associated with mycophenolate mofetil and mycophenolic acid, characterised by fever, arthralgia, arthritis, muscle pain and elevated inflammatory markers. Literature case reports showed rapid improvement following discontinuation of the medicinal product.

### Special populations

#### Paediatric population

The type and frequency of adverse reactions were assessed in a long-term clinical trial, which recruited 33 paediatric renal transplant patients, aged 3 years to 18 years, who were given 23 mg/kg of mycophenolate mofetil orally, twice daily. Overall, the safety profile in these 33 children and adolescents was similar to that observed in adult recipients of solid organ allografts.

Similar observations were made in another clinical trial, which recruited 100 paediatric renal transplant patients aged 1 to 18 years. The type and frequency of adverse reactions in patients who were given 600 mg/m<sup>2</sup>, up to 1 g/m<sup>2</sup> of mycophenolate mofetil orally, twice daily, were comparable to those observed in adult patients given 1 g mycophenolate mofetil twice daily. A summary of the more frequently occurring adverse reactions is shown in table 3 below:

**Table 3 Summary of adverse reactions observed more frequently in a trial investigating mycophenolate mofetil in 100 paediatric renal transplant patients (age/surface area-based dosing [600 mg/m<sup>2</sup>, up to 1 g/m<sup>2</sup> BID.]**

<b>Adverse reaction (MedDRA) System Organ Class</b>	<b>&lt;6 years (n=33)</b>	<b>6-11 years (n=34)</b>	<b>12-18 years (n=33)</b>
<b>Infections and infestations</b>	Very common (48.5%)	Very common (44.1%)	Very common (51.5%)
<b>Blood and lymphatic system disorders</b>			
Leukopenia	Very common (30.3%)	Very common (29.4%)	Very common (12.1%)
Anaemia	Very common (51.5%)	Very common (32.4%)	Very common (27.3%)
<b>Gastrointestinal disorders</b>			
Diarrhoea	Very common (87.9%)	Very common (67.6%)	Very common (30.3%)
Vomiting	Very common (69.7%)	Very common (44.1%)	Very common (36.4%)

Based on limited sub-set data (i.e. 33 of the 100 patients) there was a higher frequency of severe diarrhoea (common, 9.1%), and candida mucocutaneous (very common, 21.2%) in children under 6 years of age, compared to the older paediatric cohort in which no cases of severe diarrhoea were reported (0.0%) and candida mucocutaneous was common (7.5%).

Review of the available medical literature on paediatric hepatic and cardiac transplant patients shows the type and frequency of the reported adverse reactions are consistent with those observed in paediatric and adult patients following renal transplant.

Very limited post-marketing data indicates a higher frequency of the following adverse reactions in patients under 6 years of age compared to older patients (see section 4.4):

- lymphomas and other malignancies particularly of post-transplant lymphoproliferative disorder in cardiac transplant patients
- blood and lymphatic system disorders including anaemia and neutropenia in cardiac transplant patients under 6 years of age compared to older patients, and compared to paediatric hepatic/renal transplant recipients
- gastrointestinal disorders including diarrhoea and vomiting.

Renal transplant patients under 2 years of age might be at a higher risk of infections and respiratory events compared to older patients. However, these data should be interpreted with caution due to a very limited number of post-marketing reports concerning the same patients suffering from multiple infections.

In case of undesirable effects, temporary dose reduction or interruption may be considered as deemed clinically necessary.

#### Elderly

Elderly patients ( $\geq 65$  years) may generally be at increased risk of adverse reactions due to immunosuppression. Elderly patients receiving mycophenolate mofetil as part of a combination immunosuppressive regimen may be at increased risk of certain infections (including cytomegalovirus tissue invasive disease) and possibly gastrointestinal haemorrhage and pulmonary oedema, compared to younger individuals.

#### Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reaction via the Yellow Card Scheme. Website: [www.mhra.gov.uk/yellowcard](http://www.mhra.gov.uk/yellowcard) or search for MHRA Yellow Card in the Google Play or Apple App Store.

## **4.9 Overdose**

Reports of overdoses with mycophenolate mofetil have been received from clinical trials and during post-marketing experience. In many of these cases, no adverse events were reported. In those overdose cases in which adverse events were reported, the events fall within the known safety profile of the medicinal product and had a favourable outcome. However, isolated serious

adverse events including a fatal case were observed during post-marketing experience.

It is expected that an overdose of mycophenolate mofetil could possibly result in oversuppression of the immune system and increase susceptibility to infections and bone marrow suppression (see section 4.4). If neutropenia develops, dosing with mycophenolate mofetil should be interrupted or the dose reduced (see section 4.4).

Haemodialysis would not be expected to remove clinically significant amounts of MPA or MPAG. Bile acid sequestrants, such as cholestyramine, can remove MPA by decreasing the enterohepatic recirculation of the drug (see section 5.2).

## 5.1 Pharmacodynamic properties

Pharmacotherapeutic group: immunosuppressive agents ATC code L04AA06

### Mechanism of action

Mycophenolate mofetil is the 2-morpholinoethyl ester of MPA. MPA is, selective, uncompetitive and reversible inhibitor of IMPDH, and therefore inhibits the *de novo* pathway of guanosine nucleotide synthesis without incorporation into DNA. Because T- and B-lymphocytes are critically dependent for their proliferation on *de novo* synthesis of purines whereas other cell types can utilise salvage pathways, MPA has more potent cytostatic effects on lymphocytes than on other cells.

In addition to its inhibition of IMPDH and the resulting deprivation of lymphocytes, MPA also influences cellular checkpoints responsible for metabolic programming of lymphocytes. It has been shown, using human CD4+ T-cells, that MPA shifts transcriptional activities in lymphocytes from a proliferative state to catabolic processes relevant to metabolism and survival leading to an anergic state of T-cells, whereby the cells become unresponsive to their specific antigen.

## 5.2 Pharmacokinetic properties

### Absorption

Following oral administration, mycophenolate mofetil undergoes rapid and extensive absorption and complete presystemic metabolism to the active metabolite, MPA. As evidenced by suppression of acute rejection following renal transplantation, the immunosuppressant activity of mycophenolate mofetil is correlated with MPA concentration. The mean bioavailability of oral mycophenolate mofetil, based on MPA AUC, is 94% relative to IV mycophenolate mofetil. Food had no effect on the extent of absorption (MPA AUC) of mycophenolate mofetil when administered at doses of 1.5 g BID to renal transplant patients. However, MPA  $C_{max}$  was decreased by 40% in the presence of food. Mycophenolate mofetil is not measurable systemically in plasma following oral administration.

### Distribution

As a result of enterohepatic recirculation, secondary increases in plasma MPA concentration are usually observed at approximately 6 – 12 hours post-dose. A reduction in the AUC of MPA of approximately 40% is associated with the co-administration of cholestyramine (4 g TID), indicating that there is a significant amount of enterohepatic recirculation.

MPA at clinically relevant concentrations is 97% bound to plasma albumin.

In the early post-transplant period (< 40 days post-transplant), renal, cardiac and hepatic transplant patients had mean MPA AUCs approximately 30% lower and C<sub>max</sub> approximately 40% lower compared to the late post-transplant period (3 – 6 months post-transplant).

### Biotransformation

MPA is metabolised principally by glucuronyl transferase (isoform UGT1A9) to form the inactive phenolic glucuronide of MPA (MPAG). *In vivo*, MPAG is converted back to free MPA via enterohepatic recirculation. A minor acylglucuronide (AcMPAG) is also formed. AcMPAG is pharmacologically active and is suspected to be responsible for some of MMF's side effects (diarrhoea, leukopenia).

### Elimination

A negligible amount of substance is excreted as MPA (< 1% of the dose) in the urine. Oral administration of radiolabelled mycophenolate mofetil results in complete recovery of the administered dose, with 93% of the administered dose recovered in the urine and 6% recovered in the faeces. Most (about 87%) of the administered dose is excreted in the urine as MPAG.

At clinically encountered concentrations, MPA and MPAG are not removed by haemodialysis. However, at high MPAG plasma concentrations (> 100 µg/mL), small amounts of MPAG are removed. By interfering with enterohepatic recirculation of the drug, bile acid sequestrants such as cholestyramine, reduce MPA AUC (see section 4.9).

MPA's disposition depends on several transporters. Organic anion-transporting polypeptides (OATPs) and multidrug resistance-associated protein 2 (MRP2) are involved in MPA's disposition; OATP isoforms, MRP2 and breast cancer resistance protein (BCRP) are transporters associated with the glucuronides' biliary excretion. Multidrug resistance protein 1 (MDR1) is also able to transport MPA, but its contribution seems to be confined to the absorption process. In the kidney, MPA and its metabolites potentially interact with renal organic anion transporters.

Enterohepatic recirculation interferes with accurate determination of MPA's disposition parameters; only apparent values can be indicated. In healthy volunteers and patients with autoimmune disease approximate clearance values of 10.6 L/h and 8.27 L/h respectively and half-life values of 17 h were observed. In transplant patients mean clearance values were higher (range

11.9-34.9 L/h) and mean half-life values shorter (5-11 h) with little difference between renal, hepatic or cardiac transplant patients. In the individual patients, these elimination parameters vary based on type of co-treatment with other immunosuppressants, time post-transplantation, plasma albumin concentration and renal function. These factors explain why reduced exposure is seen when Mycophenolate is co-administered with cyclosporine (see section 4.5) and why plasma concentrations tend to increase over time compared to what is observed immediately after transplantation.

### Special populations

#### Renal impairment

In a single dose study (6 subjects/group), mean plasma MPA AUC observed in subjects with severe chronic renal impairment (glomerular filtration rate < 25mL/min/1.73 m<sup>2</sup>) were 28 – 75% higher relative to the means observed in normal healthy subjects or subjects with lesser degrees of renal impairment. The mean single dose MPAG AUC was 3 – 6-fold higher in subjects with severe renal impairment than in subjects with mild renal impairment or normal healthy subjects, consistent with the known renal elimination of MPAG. Multiple dosing of mycophenolate mofetil in patients with severe chronic renal impairment has not been studied. No data are available for cardiac or hepatic transplant patients with severe chronic renal impairment.

#### Delayed renal graft function

In patients with delayed renal graft function post-transplant, mean MPA AUC<sub>0-12h</sub> was comparable to that seen in post-transplant patients without delayed graft function. Mean plasma MPAG AUC<sub>0-12h</sub> was 2 – 3-fold higher than in post-transplant patients without delayed graft function. There may be a transient increase in the free fraction and concentration of plasma MPA in patients with delayed renal graft function. Dose adjustment of mycophenolate mofetil does not appear to be necessary.

#### Hepatic impairment

In volunteers with alcoholic cirrhosis, hepatic MPA glucuronidation processes were relatively unaffected by hepatic parenchymal disease. Effects of hepatic disease on this process probably depend on the particular disease. However, hepatic disease with predominantly biliary damage, such as primary biliary cirrhosis, may show a different effect.

#### Paediatric population

In 33 paediatric renal allograft recipients it was established that the dose predicted to provide an MPA AUC<sub>0-12h</sub> closest to the target exposure of 27.2 h mg/l was 600 mg/m<sup>2</sup>, and that doses calculated based on estimated BSA reduced interindividual variability (coefficient of variation, (CV)) by about 10%. Therefore, dosing based on BSA is preferred rather than dosing based on body weight.

Pharmacokinetic parameters were evaluated in up to 55 paediatric renal transplant patients (aged 1 to 18 years) given 600 mg/m<sup>2</sup>, up to 1 g/m<sup>2</sup> of mycophenolate mofetil orally twice daily. This dose achieved MPA AUC values similar to those

seen in adult renal transplant patients receiving mycophenolate mofetil at a dose of 1 g BID in the early and late post-transplant period. MPA AUC values across age groups were similar in the early and late post-transplant period. For paediatric hepatic transplant recipients an open-label study of the safety, tolerability and pharmacokinetics of oral mycophenolate mofetil included 7 evaluable patients on concomitant ciclosporin and corticosteroid treatment. The dose predicted to achieve an exposure of 58 h mg/l in the stable post-transplant period was estimated. The mean  $\pm$  SD AUC<sub>0-12</sub> (adjusted to a dose of 600 mg/m<sup>2</sup>) was 47.0 $\pm$ 21.8 h mg/l, adjusted C<sub>max</sub> was 14.5 $\pm$ 4.21 mg/l, with a median time to maximum concentration of 0.75 h. To achieve the target AUC<sub>0-12</sub> of 58 h mg/l in the late post-transplant period, a dose in the range of 740-806 mg/m<sup>2</sup> BID would therefore have been required in the study population.

A comparison of dose-normalised (to 600 mg/m<sup>2</sup>) MPA AUC values in 12 paediatric renal transplant patients less than 6 years of age at 9 months post-transplant with those values in 7 paediatric hepatic transplant patients [median age 17 months (range: 10-60 months at enrolment)] at 6 months and beyond post-transplant revealed that, at the same dose, the AUC values were on average 23% lower in the paediatric hepatic patients compared to paediatric renal patients. This is consistent with the need for higher dosing in adult hepatic transplant patients compared to adult renal transplant patients to achieve the same exposure.

In adult transplant patients administered the same dosage of mycophenolate mofetil, there is similar MPA exposure among renal transplant and cardiac transplant patients. In line with the established similarity in MPA exposure between paediatric renal transplant and adult renal transplant patients at their respective approved doses, existing data allows to conclude that MPA exposure at the recommended dosage will be similar in paediatric cardiac transplant, and adult cardiac transplant patients.

**Table 4 Mean computed MPA PK parameters by age and time post-transplant (renal)**

Age group (n)	Adjusted C <sub>max</sub> mg/l <sup>A</sup> mean $\pm$ SD	Adjusted AUC <sub>0-12</sub> h mg/l mean $\pm$ SD (CI) <sup>A</sup>
<b>Day 7</b>		
<6 y (17)	13.2 $\pm$ 7.16	27.4 $\pm$ 9.54 (22.8-31.9)
6 - <12 y (16)	13.1 $\pm$ 6.30	33.2 $\pm$ 12.1 (27.3-39.2)
12-18 y (21)	11.7 $\pm$ 10.7	26.3 $\pm$ 9.14 (22.3-30.3) <sup>D</sup>
p-value <sup>B</sup>	-	-
<2 y <sup>C</sup> (6)	10.3 $\pm$ 5.80	22.5 $\pm$ 6.68 (17.2-27.8)
>18 y (141)		27.2 $\pm$ 11.6
<b>Month 3</b>		
<6 y (15)	22.7 $\pm$ 10.1	49.7 $\pm$ 18.2

6 - <12 y (14) <sup>E</sup>	27.8±14.3	61.9±19.6
12-18 y (17)	17.9±9.57	53.6±20.2 <sup>F</sup>
p-value <sup>B</sup>	-	-
<2 y <sup>C</sup> (4)	23.8±13.4	47.4±14.7
>18 y (104)	50.3±23.1	
<b>Month 9</b>		
<6 y (12)	30.4±9.16	60.9±10.7
6 - <12 y (11)	29.2±12.6	66.8±21.2
12-18 y (14)	18.1±7.29	56.7±14.0
p-value <sup>B</sup>	0.004	-
<2 y <sup>C</sup> (4)	25.6±4.25	55.8±11.6
>18 y (70)		53.5±18.3

AUC<sub>0-12h</sub>=area under the plasma concentration-time curve from time 0 h to time 12 h; CI=confidence interval;

C<sub>max</sub>=maximum concentration; MPA=mycophenolic acid; SD=standard deviation; n=number of patients; y=year.

<sup>A</sup> In the paediatric age groups C<sub>max</sub> and AUC<sub>0-12h</sub> are adjusted to a dose of 600mg/m<sup>2</sup> (95% confidence intervals (CIs) for AUC<sub>0-12h</sub> Day 7 only); in the adult group AUC<sub>0-12h</sub> is adjusted to a dose of 1 g.

<sup>B</sup> p-value represents the combined p-value for the three major paediatric age groups, and is noted only if significant (p <0.05).

<sup>C</sup> The <2-year group is a subset of the <6-year group: no statistical comparisons were made.

<sup>D</sup> n=20.

<sup>E</sup> Data for one patient was unavailable due to sampling error.

<sup>F</sup> n=16.

### Elderly

The pharmacokinetics of mycophenolate mofetil and its metabolites have not been found to be altered in the elderly patients (≥ 65 years) when compared to younger patients.

### Patients taking oral contraceptives

A study of the co-administration of mycophenolate mofetil (1 g BID) and combined oral contraceptives containing ethinylestradiol (0.02 mg to 0.04 mg) and levonorgestrel (0.05 mg to 0.15 mg), desogestrel (0.15 mg) or gestodene (0.05 mg to 0.10 mg) conducted in 18 non-transplant women (not taking other immunosuppressants) over 3 consecutive menstrual cycles showed no clinically relevant influence of mycophenolate mofetil on the ovulation suppressing action of the oral contraceptives. Serum levels of LH, FSH and progesterone were not significantly affected. The pharmacokinetics of oral contraceptives were unaffected by co-administration of mycophenolate mofetil (see also section 4.5).

## 5.3 Preclinical safety data

In experimental models, mycophenolate mofetil was not tumourigenic. The highest dose tested in the animal carcinogenicity studies resulted in approximately 2 – 3 times the systemic exposure (AUC or  $C_{max}$ ) observed in renal transplant patients at the recommended clinical dose of 2 g/day and 1.3 – 2 times the systemic exposure (AUC or  $C_{max}$ ) observed in cardiac transplant patients at the recommended clinical dose of 3 g/day.

Two genotoxicity assays (*in vitro* mouse lymphoma assay and *in vivo* mouse bone marrow micronucleus test) showed a potential of mycophenolate mofetil to cause chromosomal aberrations. These effects can be related to the pharmacodynamic mode of action, i.e. inhibition of nucleotide synthesis in sensitive cells. Other *in vitro* tests for detection of gene mutation did not demonstrate genotoxic activity.

In teratology studies in rats and rabbits, foetal resorptions and malformations occurred in rats at 6 mg/kg/day (including anophthalmia, agnathia, and hydrocephaly) and in rabbits at 90 mg/kg/day (including cardiovascular and renal anomalies, such as ectopia cordis and ectopic kidneys, and diaphragmatic and umbilical hernia), in the absence of maternal toxicity. The systemic exposure at these levels is approximately equivalent to or less than 0.5 times the clinical exposure at the recommended clinical dose of 2 g/day for renal transplant patients and approximately 0.3 times the clinical exposure at the recommended clinical dose of 3 g/day for cardiac transplant patients (see section 4.6).

The haematopoietic and lymphoid systems were the primary organs affected in toxicology studies conducted with mycophenolate mofetil in the rat, mouse, dog and monkey. These effects occurred at systemic exposure levels that are equivalent to or less than the clinical exposure at the recommended dose of 2 g/day for renal transplant recipients. Gastrointestinal effects were observed in the dog at systemic exposure levels equivalent to or less than the clinical exposure at the recommended dose. Gastrointestinal and renal effects consistent with dehydration were also observed in the monkey at the highest dose (systemic exposure levels equivalent to or greater than clinical exposure). The nonclinical toxicity profile of mycophenolate mofetil appears to be consistent with adverse events observed in human clinical trials, which now provide safety data of more relevance to the patient population (see section 4.8).

## **6 PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

Xanthan gum (E415)

Glycerol (E422)

Liquid sorbitol (non-crystallising, as 70% solution), (E420)

30% simethicone emulsion (containing benzoic acid (E210))

Methyl parahydroxybenzoate (E218)

Propyl parahydroxybenzoate (E216)

Polysorbate 80 (E433)

Sodium dihydrogen phosphate dihydrate (E339)

Disodium phosphate dihydrate (E339)

Raspberry flavour (containing propylene glycol (E1520), benzyl alcohol (E1519) and ethanol)

Purified water

## **6.2 Incompatibilities**

Not applicable

## **6.3 Shelf life**

18 months

*After first opening of the bottle: 60 days.*

## **6.4 Special precautions for storage**

*Unopened bottle: Do not store above 25°C.*

*After first opening of the bottle: Do not store above 25°C.*

## **6.5 Nature and contents of container**

Mycophenolate Mofetil Oral Suspension is packaged in a HDPE bottle with a white child-resistant, tamper-evident closure, containing 175 ml of suspension.

The package contains a 10 ml oral syringe with a purple plunger and a bottle adaptor. The graduations on the oral syringe are printed every 0.25 ml.

## **6.6 Special precautions for disposal**

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

## Instructions for use

The oral suspension must be shaken well before use.

- Open the bottle: press the cap and turn it anticlockwise (figure 1)

①



- Separate the adaptor from the syringe (figure 2). Insert the adaptor into the bottle neck (figure 3). Ensure it is well fixed.

②

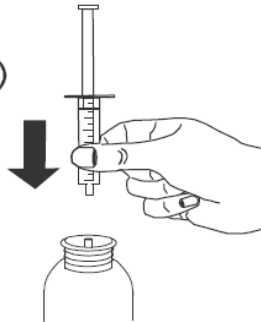


③

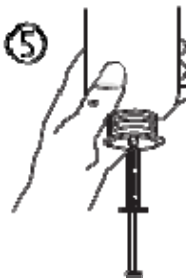


- Take the syringe and put it in the adaptor opening (figure 4). Turn the bottle upside down (figure 5).

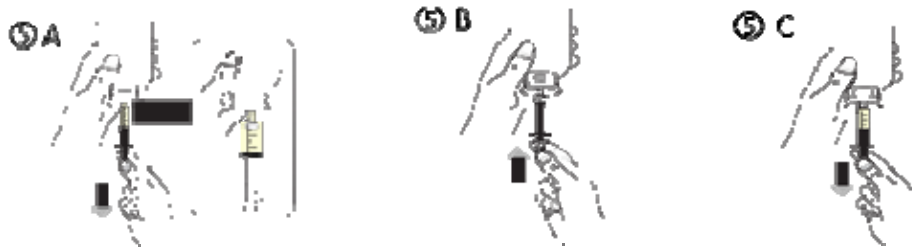
④



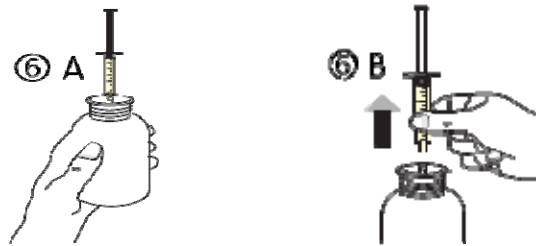
⑤



- Fill the syringe with a small amount of suspension by pulling the piston down (figure 5A), then push the piston upward in order to remove any possible bubble (figure 5B). Pull the piston down to the graduation mark corresponding to the quantity in millilitres (ml) prescribed by your doctor (figure 5C).



- Turn the bottle the right way up (figure 6A). Remove the syringe from the adaptor (figure 6B).



- Close the bottle with the plastic screw cap.
- Empty the contents of the syringe directly into your mouth. Do not mix the medicine.

with any other liquid when you swallow it.

- Immediately after use, take the syringe to pieces and rinse it under running tap water. Allow it to dry in the air before using it again. Do not use solvent-containing wipes for cleaning. Do not use cloths or wipes for drying.

**Instruction for administration via nasogastric (NG) or percutaneous endoscopic gastrostomy (PEG) tubes:**

Ensure that the enteral feeding tube is free from obstruction before administration.

1. Administer the required dose of Mycophenolate Oral Suspension gently and slowly into enteral tube, with a suitable measuring device.
2. Flush the enteral tube with water. A flush volume of 7.5mL is required. However, for longer tubes (over 40 cm) flush volume of 50mL should be used.

This product has not been tested with latex NG or PEG tubes and therefore should not be used with tubes made from latex.

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

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**8      MARKETING AUTHORISATION NUMBER(S)**

PLGB 00427/0272

**9      DATE OF FIRST AUTHORISATION/RENEWAL OF THE  
AUTHORISATION**

31/08/2023

**10     DATE OF REVISION OF THE TEXT**

08/04/2026