

# SANDIMMUN<sup>®</sup>

## (cyclosporin)

Immunosuppressive agent

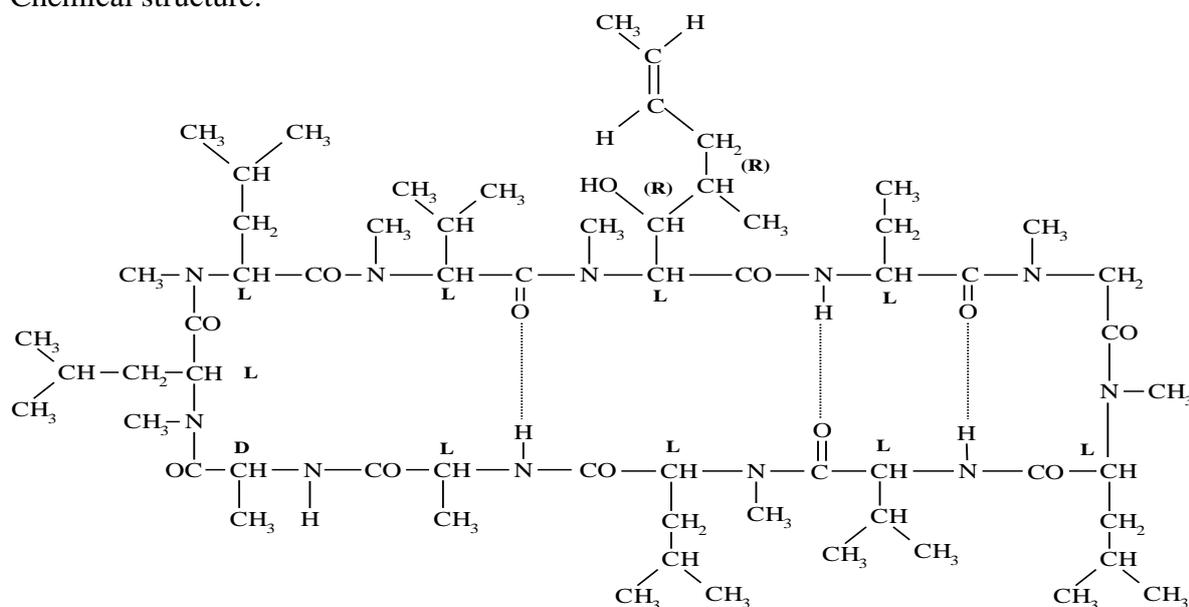
### DESCRIPTION

Cyclosporin (BAN, AAN), ciclosporin (prop. INN), cyclosporine (USAN), also known as Cyclosporin A. A cyclic polypeptide consisting of 11 amino acids. It is produced as a metabolite by the fungus species *Beauveria nivea* (formerly *Tolypocladium inflatum* Gams).

Chemical Name: Cyclo[[*(2S,3R,4R,6E)*-3-hydroxy-4-methyl-2-(methylamino)oct-6-enoyl]-*L*-2-aminobutanoyl-*N*-methylglycyl-*N*-methyl-*L*-leucyl-*L*-valyl-*N*-methyl-*L*-leucyl-*L*-alanyl-*D*-alanyl-*N*-methyl-*L*-leucyl-*N*-methyl-*L*-leucyl-*N*-methyl-*L*-valyl]

Chemical formula: C<sub>62</sub>H<sub>111</sub>N<sub>11</sub>O<sub>12</sub>

Chemical structure:



Molecular Weight: 1202.635

CAS Number: 59865-13-3

Cyclosporin is poorly soluble in water (0.004% w/w) and n-hexane, but is very soluble in other organic solvents and in lipids.

### Excipients

Sandimmun capsules and oral solution contain maize oil, ethanol (see PRECAUTIONS), and inter-esterified maize oil.

Sandimmun soft gelatin capsule shells contain gelatin, glycerol, titanium dioxide, iron oxide red CI77491 (25 and 100 mg capsules only), iron oxide yellow CI 77492 (50 mg capsules), and Anidrisorb 85/70 (sorbitol syrup).

Sandimmun concentrate for intravenous infusion contains castor oil – polyoxyethylated, macrogolglycerol ricinoleate (Cremophor<sup>®</sup> EL) 65 %, and ethanol 26 % w/v (see PRECAUTIONS).

## **PHARMACOLOGY**

### **Pharmacodynamic properties**

Pharmacotherapeutic group: immunosuppressive agents, calcineurin inhibitors

ATC Code: L04A D01

Cyclosporin is a potent immunosuppressive agent which prevents or delays rejection of solid organ allografts or xenografts in various animal models including skin, heart, kidney, pancreas, small intestine and lung.

It delays the onset of graft versus host disease after bone marrow transplantation in rodents. Successful kidney, pancreas, liver, heart, bone marrow and heart-lung allogeneic transplants have been performed in man using cyclosporin.

Cyclosporin may be used alone or with low-dose corticosteroids in the prophylaxis of organ rejection following solid organ transplants. It may also be used in the treatment of transplant rejection in patients previously receiving other immunosuppressive agents.

Beneficial effects of cyclosporin therapy have also been shown in some cases of nephrotic syndrome, rheumatoid arthritis, psoriasis and atopic dermatitis (see INDICATIONS). Cyclosporin is thought to be effective in these diseases since they are known or appear to be of autoimmune origin.

Studies in animals suggest that cyclosporin inhibits the development of cell-mediated reactions, including allograft immunity, delayed cutaneous hypersensitivity, experimental allergic encephalomyelitis, Freund's adjuvant arthritis, graft-versus-host disease and also T-cell dependent antibody production. It also inhibits lymphokine production and release, including interleukin 2 or T-cell growth factor (TCGF). Cyclosporin appears to block the resting lymphocytes in the G<sub>0</sub> or G<sub>1</sub> phase of the cell cycle, and inhibits the antigen-triggered release of lymphokines by activated T-cells.

All available evidence suggests that cyclosporin acts specifically and reversibly on lymphocytes. Unlike cytostatic agents, it does not depress haemopoiesis and has no effect on the function of phagocytic cells. Therefore, it may be expected that patients treated with cyclosporin may be less prone to infection than those receiving other immunosuppressive therapy. This was reported in two randomised trials of cyclosporin versus standard immunotherapy but was not found in a third.

### **Clinical Trials on Use in Severe Atopic Dermatitis**

The use of cyclosporin in severe atopic dermatitis was supported primarily by the results of two prospective, double-blind, placebo-controlled, crossover trials conducted over an 8-week treatment period (Studies SIM 79 & SIM 80) and a double-blind, placebo-controlled, parallel-group study conducted over a 6-week treatment period (Study SIM 24). A dose of 5 mg/kg per day was used throughout these three studies. In addition, five open-labelled studies were performed to examine relapse rates following cyclosporin withdrawal or the effects of long-term therapy and different dosing strategies. In one of these studies (SIM SF04), 5 mg/kg per day of the drug was given for 6 weeks, then the relapse rates were observed over a further 6 weeks; patients who relapsed were then given a second course of cyclosporin and monitored again for relapse. In the long-term studies, the dose of cyclosporin was adjusted according to response and side-effects. In several of the open studies, patients were commenced on a low cyclosporin dose (2.5-3.0 mg/kg per day), which was then adjusted if necessary.

A total of 86 patients were treated with cyclosporin in the placebo-controlled studies and about 250 patients were entered into the open-labelled studies, of which 178 were involved in long-term studies (98 of whom were treated for at least 12 months). Most of the patients

treated in the clinical programme were adults who had severe, long-standing atopic dermatitis that was resistant to conventional therapy and/or caused significant suffering and disability. In the controlled studies and in most of the open-label studies, the primary measures of efficacy were the area of skin involvement and the severity of the skin disease. Other measures included itch and loss of sleep scores, the extent of topical steroid use, and a patient assessment of symptoms.

The results of the placebo-controlled studies demonstrated that cyclosporin is highly effective in the majority of patients with severe atopic dermatitis; only 5 of the 86 patients treated in these studies failed to respond to therapy. The results of the long-term studies showed that efficacy could be maintained at doses less than 5 mg/kg per day over the duration of these studies, although due to their uncontrolled nature, it is difficult to assess the effects of the natural course of the disease on the long-term results. In Study SIM SF04, 43% and 52% of patients relapsed 2 weeks after cessation of the first and second course of cyclosporin therapy respectively; the relapse rate climbed to 71 and 87% respectively after 6 weeks. As expected, patients who commenced on a low cyclosporin dose followed by a dose adjustment did not respond as well initially as those who started on a high dose, but eventually the response rate for both groups was similar. While adverse events were frequent in the controlled studies, these were nevertheless consistent with the known side-effect profile of cyclosporin. Nephrotoxicity and hypertension, normally a concern with cyclosporin use, were observed only in a few patients in the short-term studies.

### **Pharmacokinetics**

#### **Absorption:**

The absorption of cyclosporin from the gastrointestinal tract is incomplete and variable and not consistently affected by food. Peak blood concentrations are achieved at about 3.5 hours following single-dose administration and within 1 to 6 hours in steady-state. The absolute bioavailability of the oral forms is 20-50% at steady-state; the capsules and the oral solution have been found to be bioequivalent. The plasma concentration achieved is proportional to the dose administered up to 1400 mg, although the relationship is non-linear for whole blood. As determined by a specific HPLC assay, C<sub>max</sub> is approximately 0.95 ng/mL per mg of oral dose for plasma and 2.7-1.4 for blood (for low to high doses). A 3.5 mg/kg infusion over 4 hours produces peak blood levels of 1500-2230 ng/mL.

#### **Distribution:**

Cyclosporin is distributed largely outside the blood volume with an apparent volume of distribution of 3.5 L/kg (average). Within the blood, distribution is concentration-dependent, with 33-47% present in plasma, 4-9% in lymphocytes, 5-12% in granulocytes and 41-58% in erythrocytes. At higher concentrations the leucocytes and erythrocytes become saturated. In plasma, approximately 90% is bound to proteins, mostly lipoproteins.

#### **Metabolism:**

Cyclosporin is extensively biotransformed to approximately 15 metabolites. There is no single major metabolic pathway. All metabolites identified so far contain the intact cyclic peptide structure of the parent compound. Major pathways consist of mono- and dihydroxylation and N-demethylation at various positions. Hepatic dysfunction, as measured by a rise in serum bilirubin, may be associated with a proportional rise in cyclosporin blood levels.

#### **Excretion:**

There is a high variability in the data reported on the terminal half-life of cyclosporin, depending on the assay applied and on the target population. The terminal half-life ranged

from 6.3 hours in healthy volunteers to 20.4 hours in patients with severe liver disease. Elimination is primarily biliary with only 6% of the oral dose excreted in the urine, of which only 0.1% is unchanged drug.

## **INDICATIONS**

Sandimmun is indicated:

- As an immunosuppressive agent for the prevention of graft rejection following kidney, liver and heart allogeneic transplantation.
- For induction and/or maintenance of remission in the nephrotic syndrome. Cyclosporin is not a first-line agent. Its use should be restricted to occasions when steroids and cytostatic drugs have failed, or are not tolerated, or are considered inappropriate, and when renal function is unimpaired (see PRECAUTIONS).
- For the treatment of severe, active rheumatoid arthritis in patients for whom classical slow-acting antirheumatic agents (including methotrexate) are inappropriate or ineffective.
- In patients with severe psoriasis in whom conventional therapy is ineffective or inappropriate and the disease has caused a significant interference with quality of life.
- For the treatment of severe atopic dermatitis when other treatment is ineffective or inappropriate.

**Careful monitoring of all cyclosporin-treated patients is mandatory. Cyclosporin should only be used by medical practitioners who are experienced in the use of immunosuppressive therapy (see PRECAUTIONS).**

## **CONTRAINDICATIONS**

### **All Indications**

Known hypersensitivity to cyclosporin and/or polyoxyethylated castor oil (Cremophor<sup>®</sup> EL) or any of the other excipients of Sandimmun. Note that only the concentrate for infusion contains polyoxyethylated castor oil.

### **Non-transplant Indications**

Uncontrolled hypertension, uncontrolled infection. Primary or secondary immunodeficiency excluding autoimmune diseases and selective IgA deficiency.

The use of cyclosporin in nephrotic syndrome is contraindicated in patients with impaired baseline renal function (serum creatinine >200 micromol/L in adults and >140 micromol/L in children). In other non-transplant indications, cyclosporin is contraindicated in patients with impaired renal function of any degree of severity.

## **PRECAUTIONS**

### **General Precautions**

#### **Patient management:**

Only physicians experienced in immunosuppressive therapy and the management of kidney, heart and liver transplant patients and/or in the management of nephrotic syndrome, severe rheumatoid arthritis, severe psoriasis or severe atopic dermatitis should use cyclosporin. Patients receiving the drug should be managed in facilities equipped and staffed with adequate laboratory and supportive medical resources. The physician responsible for maintenance therapy should receive complete information for the follow-up of the patient.

**Monitoring cyclosporin levels in transplant patients**

When Sandimmun is used in transplant patients, routine monitoring of cyclosporin blood levels is an important safety measure (see DOSAGE AND ADMINISTRATION).

**Development of malignancies:**

Like other immunosuppressants, cyclosporin increases the risk of developing lymphomas and other malignancies, particularly those of the skin. The increased risk appears to be related to the degree and duration of immunosuppression rather than to the use of specific agents. Hence, a treatment regimen containing multiple immunosuppressants (including cyclosporin) should be used with caution as this could lead to lymphoproliferative disorders and solid organ tumours, some with reported fatalities (see ADVERSE EFFECTS).

Because of the significantly increased risk over time of developing skin cancers, patients taking cyclosporin should be strongly advised to avoid excessive unprotected exposure to ultraviolet light or the sun.

There is limited long-term information on the development of possible malignancy and chronic nephrotoxicity following the use of cyclosporin.

**Development of infections:**

Like other immunosuppressants, cyclosporin predisposes patients to the development of a variety of bacterial, fungal, parasitic and viral infections, often with opportunistic pathogens. Activation of latent Polyomavirus infections that may lead to Polyomavirus associated nephropathy (PVAN), especially to BK virus nephropathy (BKVN), or to JC virus associated progressive multifocal leukoencephalopathy (PML) have been observed in patients receiving cyclosporin. These conditions are often related to a high total immunosuppressive burden and should be considered in the differential diagnosis in immunosuppressed patients with deteriorating renal function or neurological symptoms. Serious and/or fatal outcomes have been reported. Effective pre-emptive and therapeutic strategies should be employed, particularly in patients on multiple long-term immunosuppressive therapy (see ADVERSE EFFECTS).

**Impairment of renal function:**

Cyclosporin may cause increases in serum creatinine and urea levels, even at recommended doses, as a result of a reduced glomerular filtration rate. The mechanism leading to these changes is not fully understood. These changes are usually dose-dependent and reversible with reduction of cyclosporin dosage. Structural changes to the kidney (eg. interstitial fibrosis) may also occur, usually at higher cyclosporin dose levels. Although these renal changes are less common than functional changes, they may be irreversible. In non-transplant indications, the risk of renal structural changes is greater if the serum creatinine level increases by more than 30% from the patient's own baseline value. Thus regular measurements of serum creatinine must be made. In renal transplant patients who have received long-term treatment with cyclosporin, structural changes in the kidney must be differentiated from organ rejection.

Close monitoring of all parameters is required, with dose adjustments when indicated.

**Impairment of hepatic function:**

Cyclosporin may cause increases in serum bilirubin and liver enzymes (see ADVERSE REACTIONS). There have been solicited and spontaneous postmarketing reports of hepatotoxicity and liver injury including cholestasis, jaundice, hepatitis and liver failure in patients treated with cyclosporin. Most reports included patients with significant comorbidities, underlying conditions and other confounding factors including infectious

complications and comedications with hepatotoxic potential. In some cases, mainly in transplant patients, fatal outcomes have been reported (see ADVERSE REACTIONS). These changes appear to be dose-related and reversible. Hepatic dysfunction, as measured by rises in serum bilirubin, has been found to be associated with proportional increases in serum cyclosporin levels in some cases.

**Hypertension:**

Hypertension induced by cyclosporin has been reported in up to 50 % of post-transplant patients and 8.5% of patients being treated for non-transplant indications. The pathophysiology of cyclosporin-induced nephrotoxicity and hypertension are closely related. Regular monitoring of blood pressure is required during cyclosporin therapy; if hypertension develops, appropriate antihypertensive treatment must be instituted (see ADVERSE EFFECTS). Diuretics (especially thiazide and loop diuretics) are not recommended. Concomitant use of diuretics and cyclosporin could predispose the patient to pre-renal azotemia, worsening of hyperuricaemia, glucose intolerance or hyperlipidemia. For treatment of hypertension due to cyclosporin, if calcium channel blockers are indicated, only those which do not interfere with cyclosporin pharmacokinetics are recommended (see INTERACTIONS WITH OTHER MEDICINES).

As both recombinant human erythropoietin and cyclosporin are reported to increase blood pressure in a significant number of patients, caution should be exercised when administering these agents concomitantly (see INTERACTIONS WITH OTHER MEDICINES).

**Biochemical changes:**Hyperkalaemia:

Hyperkalaemia, which may become life-threatening, can occur with cyclosporin treatment, especially in patients with renal dysfunction (see ADVERSE EFFECTS). It can be treated successfully and has also been found to disappear spontaneously. Patients receiving cyclosporin should avoid high dietary potassium intake and not be given potassium-containing medication or potassium-sparing diuretics (see INTERACTIONS WITH OTHER MEDICINES). Caution is also required when cyclosporin is co-administered with angiotensin converting enzyme inhibitors or angiotensin II receptor antagonists. Monitoring of serum potassium is recommended, especially in patients with marked renal dysfunction.

Calcium Metabolism:

Although apparently not observed so far in clinical use, physicians should be aware that in various animal studies using doses comparable with those used clinically, there were several changes indicative of a drug-related disturbance in calcium metabolism.

Hypomagnesaemia:

Hypomagnesaemia may increase the risk of cyclosporin-related neurotoxicity. Cyclosporin enhances the clearance of magnesium. This can lead to symptomatic hypomagnesaemia, especially in the peri-transplant period (see ADVERSE EFFECTS). Therefore, control of serum magnesium levels is recommended in the peri-transplant period, particularly in the presence of neurological symptoms/signs. If considered necessary, magnesium supplementation should be given.

Hyperuricaemia:

Increased incidences of hyperuricaemia and acute gout have been reported after cyclosporin treatment (see ADVERSE EFFECTS). Special monitoring of serum uric acid in high risk patients is recommended.

### Lipoprotein Abnormalities:

Recent reports suggest that cyclosporin may increase by 15 to 20% total cholesterol and low density lipoprotein cholesterol levels, as well as increase triglyceride levels, in renal and cardiac post-transplant patients. This effect does not seem to relate to total cyclosporin dose or cyclosporin plasma levels, and may be associated with risk factors other than immunosuppressive treatment. It is advisable to perform lipid determinations before treatment and after the first month of therapy. In the event of increased lipids being found, restriction of dietary fat and, if appropriate, a dose reduction should be considered (see ADVERSE EFFECTS). Drug treatment of cyclosporin-associated hyperlipidemia is usually complicated by drug interactions between cyclosporin and some lipid lowering agents (eg. nicotinic acid and bile acid sequestrants). Special care in combining lipid lowering agents with cyclosporin is recommended.

### P-glycoprotein (Pgp):

Cyclosporin may increase blood levels of concomitant medications that are substrates for the multidrug efflux transporter P-glycoprotein (Pgp) or the organic anion transporter proteins (OATP) such as aliskiren, dabigatran or bosentan. Co-administration of cyclosporine with aliskiren is not recommended. Co-administration of cyclosporine together with dabigatran or bosentan should be avoided. These recommendations are based on the potential clinical impact of these interactions (see INTERACTIONS WITH OTHER MEDICINES).

### **Hypersensitivity:**

The concentrate for i.v. infusion contains polyoxyethylated castor oil which has been reported to cause anaphylactoid reactions. These reactions consist of flushing of the face and upper thorax, and non-cardiogenic pulmonary oedema with acute respiratory distress, dyspnoea, wheezing, blood pressure changes and tachycardia. Special caution is therefore necessary in patients who have previously received i.v. injection or infusion preparations containing polyoxyethylated castor oil (e.g. a Cremophor<sup>®</sup> EL-containing preparation), or in patients with an allergic predisposition. Patients receiving Sandimmun i.v. should be under continuous observation for at least the first 30 minutes following the start of the infusion and at frequent intervals thereafter. If anaphylaxis occurs, the infusion should be discontinued. An aqueous solution of adrenaline 1:1000 and a source of oxygen should be available at the bedside.

There is some evidence that pre-treatment with antihistamines may prevent the development of subsequent anaphylaxis. However the evidence is not sufficient to recommend this course of action in every case.

The oral forms of Sandimmun do not contain polyoxyethylated castor oil.

### **Variable bioavailability:**

Due to the interindividual variations in absorption and elimination of cyclosporin, doses should be individually titrated according to clinical response, adverse reactions (especially renal or hepatic dysfunction) and trough blood levels for transplant patients in particular. Patients with malabsorption may have difficulty in achieving therapeutic levels with the oral forms of cyclosporin.

### **Vaccination:**

During treatment with cyclosporin, vaccination may be less effective and the use of live attenuated vaccines should be avoided (see INTERACTIONS WITH OTHER MEDICINES).

**Carcinogenicity:**

Carcinogenicity studies were carried out in rats and mice. A 78-week mouse study, at oral doses of 1, 4 and 16 mg/kg per day, revealed a trend towards increased incidences of lymphomas at the highest dose studied. In another study with ARK mice treated with 150 mg/kg cyclosporin in the diet, cyclosporin accelerated the development of lymphomas. In a 24-month rat study, conducted at oral doses of 0.5, 2 and 8 mg/kg per day, no significant increase in tumour incidence was reported, though the study had limited sensitivity. Cyclosporin enhanced the development of lymphomas induced in two strains of male mice by single whole body irradiation or N-methyl-n-nitrosurea. The increased incidence of lymphomas observed clinically in immunosuppressed patients may possibly be related to the degree of immunosuppression (see PRECAUTIONS - General). Malignancies including Kaposi's sarcoma have also been reported in cyclosporin treated patients.

Cyclosporin was not genotoxic in a series of assays for gene mutations and chromosomal damage. However, an assay for sister chromatid exchange in human lymphocytes *in vitro* gave indications of a positive effect at high concentrations.

**Special Excipient: Ethanol**

Sandimmun soft gelatin capsules, oral solution and concentrate for intravenous infusion all contain ethanol (ethyl alcohol). The concentrates for intravenous infusion contain 34 % v/v ethanol. The soft gelatin capsules contain 12.8 % v/v ethanol, and the oral solution contains 12.6 % v/v ethanol. The Sandimmun ethanol content should be taken into account when administered to pregnant or breast feeding women, patients presenting with liver disease or epilepsy, alcoholic patients, or children.

**Use in Special Patient Groups****Use in Organ Transplantation:**

Cyclosporin should not be used concurrently with other immunosuppressive agents except adrenal corticosteroids. However, some centres use cyclosporin along with azathioprine and corticosteroids or other immunosuppressive agents (all in low doses) with the aim of reducing the possible risk of cyclosporin-induced renal side effects (see below). Immunosuppression can lead to increased susceptibility to infection and the possible development of malignancies or lymphoproliferative disorders. Infections are most likely to occur in the first year after transplantation, with their incidence declining substantially thereafter. Bacterial infections, primarily involving the urinary tract, lungs, i.v. line-related sepsis and/or wound sites, and viral infections, typically herpes or cytomegalovirus, tend to be the most frequent.

**Acute and chronic nephrotoxicity**

A frequent and potentially serious complication, an increase in serum creatinine and urea may occur during the first few weeks of cyclosporin therapy. These functional changes are dose-dependent and reversible, usually responding to dose reduction. During long-term treatment, some patients may develop structural changes in the kidney (e.g. arteriolar hyalinosis, tubular atrophy, and interstitial fibrosis), which in renal transplant patients have to be differentiated from changes due to chronic rejection (see ADVERSE EFFECTS). Cyclosporin may also cause dose-dependent, reversible increases in serum bilirubin and occasionally in liver enzymes. Close monitoring of parameters adequate for assessing renal and hepatic function is required. Abnormal values may necessitate dose reduction (see DOSAGE AND ADMINISTRATION and PHARMACOLOGY).

Post-transplant lymphomas, both polyclonal and monoclonal, and other lymphoproliferative lesions often associated with Epstein-Barr virus infections have been reported in immunosuppressed patients including those on cyclosporin, although no causal relationship

has been established. Reduction or discontinuance of immunosuppression has caused regression of the lesions, often without subsequent rejection of the graft. The clinical incidence of lymphoma with cyclosporin does not appear to be greater than with other immunosuppressives.

Care should be taken in using cyclosporin with systemic antibiotics or other compounds that have nephrotoxic effects (see INTERACTIONS WITH OTHER MEDICINES).

### **Use in Nephrotic Syndrome**

Since cyclosporin can impair renal function, it is necessary to assess renal function frequently and to reduce the dose by 25-50% when serum creatinine increases by more than 30% above creatinine concentrations recorded before starting cyclosporin therapy. If the increase from baseline exceeds 50 %, further reductions should be considered. These recommendations apply even if the patient's values still lie within the laboratory's normal range (see DOSAGE AND ADMINISTRATION).

Cyclosporin-associated structural changes on renal biopsy have been observed without consistent alteration in serum creatinine in patients treated with cyclosporin for some months. Therefore, renal biopsy should be considered if, in the treatment of nephrotic syndrome, cyclosporin therapy has been maintained for more than one year.

Patients with nephrotic syndrome who have any kind of malignancy should not be treated with cyclosporin. In patients with nephrotic syndrome treated with immunosuppressants (including cyclosporin) the occurrence of malignancies (including Hodgkin's lymphoma) has occasionally been reported.

### **Use in Rheumatoid Arthritis**

Patients with impaired renal function, abnormal liver function, uncontrolled hypertension, uncontrolled infections or any kind of malignancy, or pre-malignant conditions such as leukoplakia, monoclonal paraproteinaemia, myelodysplastic syndrome and dysplastic naevi, should not receive cyclosporin. Cyclosporin should not be used in patients where severe complications of the heart, peripheral blood vessels or lungs are involved.

Patients with rheumatoid arthritis seem particularly susceptible to the nephrotoxic effects of cyclosporin. It appears that both the underlying disease process and the various therapies used contribute to the increased susceptibility to nephropathy. Clinical trials using lower doses of cyclosporin have reported less serious changes in renal function. However, moderate to severe and/or irreversible changes have been observed in patients receiving low doses of cyclosporin when the drug is administered long-term. The risk of nephrotoxicity further increases in patients being treated with a combination of low dose cyclosporin and non-steroidal anti-inflammatory drugs (see INTERACTIONS WITH OTHER MEDICINES).

Since cyclosporin can impair renal function, a reliable baseline level of serum creatinine should be established by at least two measurements prior to treatment, and serum creatinine should be monitored at 2-weekly intervals during the first 3 months of therapy. Thereafter, measurements can be made every 4 weeks, but more frequent checks are necessary when the cyclosporin dose is increased or concomitant treatment with a non-steroidal anti-inflammatory drug is initiated or its dosage increased (see DOSAGE AND ADMINISTRATION).

Discontinuation of the drug may become necessary if hypertension developing during cyclosporin therapy cannot be controlled by appropriate antihypertensive therapy (see INTERACTIONS WITH OTHER MEDICINES).

As with other long-term immunosuppressive treatments (including cyclosporin), an increased risk of lymphoproliferative disorders must be borne in mind. Special caution should be observed if Sandimmun is used in combination with methotrexate (see INTERACTIONS WITH OTHER MEDICINES).

**Use in Psoriasis:**

Patients with abnormal renal function, uncontrolled hypertension, uncontrolled infections ((see CONTRAINDICATIONS) or any kind of malignancy other than of the skin (see below) should not receive cyclosporin.

Since cyclosporin can impair renal function, a reliable baseline level of serum creatinine should be established by at least two measurements prior to treatment, and serum creatinine should be monitored at two-weekly intervals for the first three months of therapy. Thereafter, if creatinine remains stable, measurements should be made at monthly intervals. If the serum creatinine remains increased by more than 30% above creatinine concentrations recorded before starting cyclosporin therapy at more than one measurement, the dosage of cyclosporin must be reduced by 25-50%. These recommendations apply even if the patient's values still lie within the laboratory's normal range (see DOSAGE AND ADMINISTRATION). If a dose reduction is not successful in reducing levels within one month, cyclosporin treatment should be discontinued.

Discontinuation of cyclosporin therapy is recommended if hypertension developing during cyclosporin therapy cannot be controlled with appropriate therapy (see INTERACTIONS WITH OTHER MEDICINES).

Elderly patients should be treated only in the presence of disabling psoriasis and renal function should be monitored with particular care.

In psoriatic patients on cyclosporin, as in those on conventional therapy, development of malignancies (in particular of the skin) has been reported. It was noted in an epidemiological study of clinical trials on the use of Sandimmun in psoriasis (n=1439) that 32 cases of malignancies were reported during these trials, 17 cases of which were skin cancers; almost all of the patients who developed skin cancers had previously been exposed to PUVA. No case of melanoma was reported. In the same study, it was estimated that the risk of developing skin cancer, solid malignant tumours or lymphomas in psoriatic patients treated with Sandimmun increased by 12.40, 3.19 or 5.05 respectively over a reference population. (These estimates were corrected for the risk of developing skin or other cancers in the untreated psoriatic population, but not for the increased risk of skin and other cancers associated with previous therapy with PUVA or immunosuppressive agents other than cyclosporin). It is noteworthy that most of the data used in the study were obtained from trials conducted in the USA and northern Europe, where the baseline incidence of skin cancer is significantly lower than that in Australia. Therefore, patients undergoing cyclosporin therapy who have been exposed to excessive Australian sunlight may be expected to have a higher risk of developing skin cancers than American or European patients.

In view of the potential risk of skin cancer, patients being treated with cyclosporin should not receive concomitant ultraviolet B irradiation or PUVA photochemotherapy.

Skin lesions not typical for psoriasis but suspected to be malignant or pre-malignant should be biopsied before cyclosporin treatment is started. Patients with malignant or pre-malignant alterations of the skin should be treated with cyclosporin only after appropriate treatment of such lesions and if no other option for successful therapy exists.

In a few psoriatic patients treated with cyclosporin, lymphoproliferative disorders have occurred. These were responsive to prompt drug discontinuation.

Long term safety data on the use of cyclosporin in psoriasis are at present limited. There is only limited experience with the use of cyclosporin in children with psoriasis.

### **Use in Atopic Dermatitis**

Patients with abnormal renal function, uncontrolled hypertension, uncontrolled infections (see CONTRAINDICATIONS) or any kind of malignancy should not receive cyclosporin.

Since cyclosporin can impair renal function, a reliable baseline level of serum creatinine should be established by at least 2 measurements prior to treatment, and serum creatinine should be monitored at 2-weekly intervals for the first 3 months of therapy. Thereafter, if creatinine remains stable, measurements should be made at monthly intervals. If the serum creatinine increases and remains increased to more than 30% above baseline at more than one measurement, the dosage of cyclosporin must be reduced by 25 to 50%. These recommendations apply even if the patient's values still lie within the laboratory's normal range (see DOSAGE AND ADMINISTRATION). If dose reduction is not successful in reducing levels within one month, cyclosporin should be discontinued.

Discontinuation of cyclosporin therapy is also recommended if hypertension developing during cyclosporin therapy cannot be controlled with appropriate therapy (see ADVERSE EFFECTS).

As the experience with cyclosporin in children with atopic dermatitis is still limited to date, its use in this patient population is not recommended.

Elderly patients should be treated only in the presence of disabling atopic dermatitis and renal function should be monitored with particular care.

Benign lymphadenopathy is commonly associated with flares in atopic dermatitis and invariably disappears spontaneously or with general improvement in the disease. Lymphadenopathy observed on treatment with cyclosporin should be regularly monitored. Lymphadenopathy which persists despite improvement in disease activity should be examined by biopsy as a precautionary measure to ensure the absence of lymphoma.

Active herpes simplex infections should be allowed to clear before treatment with cyclosporin is initiated, but are not a reason for drug withdrawal if they occur during treatment, unless infection is severe.

Skin infections with *Staphylococcus aureus* are not an absolute contraindication for cyclosporin therapy, but should be controlled with appropriate antibacterial agents. Oral erythromycin, known to have the potential to increase the blood concentration of cyclosporin (see INTERACTIONS WITH OTHER MEDICINES) should be avoided or, if there is no alternative, it is recommended to closely monitor blood levels of cyclosporin, renal function, and for side effects of cyclosporin.

In view of the potential risk of skin cancer, patients on cyclosporin should be warned to avoid excess unprotected sun exposure and should not receive concomitant ultraviolet B irradiation or PUVA photochemotherapy.

### **Use in Pregnancy (Category C)**

Cyclosporin was shown to be embryo- and fetotoxic in rats and rabbits at doses toxic to dams (rat at 30 mg/kg per day and rabbit at 100 mg/kg per day orally). Toxicity was indicated by increased pre- and postnatal mortality and reduced foetal weight together with related skeletal retardations. In the well-tolerated dose range (rats up to 17 mg/kg per day and rabbits up to 30 mg/kg per day orally) cyclosporin did not demonstrate embryolethal or teratogenic effects.

In two published research studies, rabbits exposed to cyclosporin *in utero* (10 mg/kg/day subcutaneously) had reduced numbers of nephrons. These rabbits exhibited renal hypertrophy, systemic hypertension and progressive renal insufficiency when examined between 11 and 35 weeks of age in one study. The relevance of these findings for humans is unknown but cannot be dismissed.

The present experience with using cyclosporin in pregnancy is still limited. Although there is no evidence that cyclosporin has a direct teratogenic effect in man, the use of immunosuppressive therapy in general is associated with a higher risk of complications in the mother and the infant. Pregnant women receiving immunosuppressive therapies after transplantation, including cyclosporin and cyclosporin-containing regimens, are at risk of premature delivery (<37 weeks). It appears that the risk of foetal growth retardation is increased in mothers taking immunosuppressants, including cyclosporin. In addition, a few cases of foetal abnormalities, within the normal range, have been reported in association with cyclosporin use in pregnancy. No causal relationship has been established.

Cyclosporin may cause immunosuppression in the infant. The long-term effects on the offspring of mothers who have been treated with cyclosporin have not been assessed. Limited observations in 34 children exposed to cyclosporine *in utero* are available, up to a median age of 3 years (range 6 months to 7 years). Renal function was normal in all children and blood pressure was normal in the 12 children in whom it was measured.

Female transplant recipients wishing to conceive should be informed of the above mentioned risks and like all drugs, cyclosporin should be used in pregnancy only if the potential benefit justifies the potential risk to the foetus. In non-transplant patients, cyclosporin is not recommended in pregnancy where alternative treatments are available.

The ethanol content of Sandimmun formulations should also be taken into account in pregnant women (see PRECAUTIONS – Special excipient: Ethanol).

Males treated with cyclosporin have been reported to have fathered normal children.

### **Use in Lactation**

Cyclosporin passes into the breast milk. Mothers receiving treatment with cyclosporin should not, therefore, breast feed their infants. Because of the potential of Sandimmun to cause serious adverse drug reactions in breastfed newborns/infants, a decision should be made whether to abstain from breast-feeding or to abstain from using the medicinal drug, taking into account the importance of the medicinal product to the mother.

The ethanol content of Sandimmun formulations should also be taken into account (see PRECAUTIONS – Special excipient: Ethanol).

### **Use in the Elderly**

Experience in the elderly is limited, but no particular problems have been reported following use of the drug at the recommended dose. However, factors sometimes associated with aging, in particular impaired renal function, make careful supervision essential and may necessitate dosage adjustment.

In rheumatoid arthritis clinical trials with cyclosporin, 17.5% of patients were aged 65 or older. These patients were more likely to develop systolic hypertension on therapy, and more likely to show serum creatinine rises  $\geq 50\%$  above the baseline after 3-4 months of therapy. Clinical studies in transplant and psoriasis patients did not include a sufficient number of subjects aged 65 and over to determine whether they respond differently from younger subjects. Other reported clinical experiences have not identified differences in response between the elderly and younger patients.

In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal or cardiac function, and of concomitant disease or other drug therapy.

### **Use in Children**

Except for use in transplantation and in the treatment of nephrotic syndrome, there is no adequate experience available with cyclosporin; its use in children under 16 years of age for non-transplant indications other than nephrotic syndrome cannot be recommended. Also see PRECAUTIONS - Special Excipient: Ethanol.

## **INTERACTIONS WITH OTHER MEDICINES**

### **Live attenuated vaccines**

During treatment with cyclosporin, vaccination may be less effective and the use of live attenuated vaccines should be avoided (see PRECAUTIONS).

### **Potassium sparing drugs**

Caution is required for concomitant use of potassium sparing drugs (e.g. potassium sparing diuretics, angiotensin converting enzyme inhibitors, angiotensin II receptor antagonists) or potassium containing drugs, since they may lead to significant increases in serum potassium (see PRECAUTIONS).

### **Methotrexate**

Care should be taken when using cyclosporin together with methotrexate in rheumatoid arthritis patients due to the risk of nephrotoxic synergy (see PRECAUTIONS).

### **Antibiotics**

Care should be taken when using cyclosporin in conjunction with systemic antibiotics or other compounds known to have nephrotoxic effects, e.g. aminoglycosides (including gentomycin, tobramycin), amphotericin B, ciprofloxacin, melphalan, colchicine, trimethoprim (plus sulphamethoxazole) as additive nephrotoxicity has been reported to occur. Close monitoring of renal function (in particular serum creatinine) should be performed. If a significant impairment of renal function occurs, the dosage of the co-administered drug should be reduced or alternative treatment considered.

In oncology patients, the intravenous coadministration of anthracycline antibiotics and very high doses of cyclosporin has resulted in significant increased exposure in the anthracycline antibiotics (e.g. doxorubicine, mitoxanthrone, daunorubicine).

### **Tacrolimus**

Concomitant use with tacrolimus should be avoided due to increased potential for nephrotoxicity.

### **Lercanidipine**

Caution should be observed when co-administering lercanidipine with cyclosporin as the AUCs of both drugs increased with concomitant administration.

### **Everolimus, sirolimus**

Elevations in serum creatinine were observed in the studies using everolimus or sirolimus in combination with full-dose cyclosporin microemulsion (Neoral<sup>®</sup>). This effect is often reversible with cyclosporin dose reduction. Everolimus and sirolimus had only a minor influence on cyclosporin pharmacokinetics. Co-administration of cyclosporin significantly increases blood levels of everolimus and sirolimus.

### **Fibric acid derivatives**

In graft recipients there have been isolated reports of considerable but reversible impairment of kidney function (with corresponding increase in serum creatinine) following concomitant administration of fibric acid derivatives (e.g. bezafibrate, fenofibrate). Kidney function must therefore be closely monitored in these patients. In the event of significant impairment of kidney function the co-medication should be withdrawn.

### **Cytochrome P450 isozymes, P-glycoprotein (Pgp)**

Various agents, as listed in the following tables, are known to either increase or decrease the serum or whole blood concentrations of cyclosporin by competitive inhibition or induction of those hepatic enzymes involved in the metabolism or excretion of cyclosporin, in particular CYP3A4. Cyclosporin is also an inhibitor of CYP3A4 and of the multidrug efflux transporter P-glycoprotein and may increase plasma levels of comedications that are substrates of this enzyme and/or transporter. Thus it is recommended that co-administration of such drugs with cyclosporin be avoided. In situations where combined administration is unavoidable, the following basic recommendations should be observed:

- In transplant patients: frequent monitoring of cyclosporin blood levels and appropriate modification of cyclosporin dosage are essential (see DOSAGE AND ADMINISTRATION - Clinical Blood Level Monitoring). This is especially important during the introduction or withdrawal of the co-administered drug.
- In non-transplant patients: where the relationship between blood level of cyclosporin and clinical effects is less well established, frequent assessment of renal function and careful monitoring for cyclosporin-related side effects may be more appropriate.

### **Aliskiren, Dabigatran, Ambrisentan, Bosentan**

Cyclosporin may reduce the clearance of aliskiren, bosentan or dabigatran. Following concomitant administration of cyclosporin and aliskiren, the C<sub>max</sub> of aliskiren was increased by approximately 2.5 fold and the AUC by approximately 5 fold. However, the pharmacokinetic profile of cyclosporin was not significantly altered. (see PRECAUTIONS).

Concomitant administration of dabigatran and cyclosporine leads to increased plasma levels of dabigatran due to the P-gp inhibitory activity of cyclosporine (see Precautions). Dabigatran has a narrow therapeutic index and an increase in plasma level may be associated with an increased risk of bleeding.

Co-administration of bosentan and cyclosporin in healthy volunteers resulted in an increase in bosentan exposure and a decrease in cyclosporin exposure. Multiple dose administration of ambrisentan and cyclosporin in healthy volunteers resulted in an increase in ambrisentan exposure whilst cyclosporin exposure was marginally increased.

### **Food**

The bioavailability of cyclosporin has been shown to increase when the drug is taken concomitantly with grapefruit juice or a fat-rich meal. It has been suggested that grapefruit juice inhibits pre-hepatic metabolism of cyclosporin by the cytochrome P450 enzyme system in the wall of the gastrointestinal tract.

### **Nifedipine**

The concurrent administration of nifedipine with cyclosporin may result in an increased rate of gingival hyperplasia compared with that observed when cyclosporin is given alone. The concomitant use of nifedipine should be avoided in patients in whom gingival hyperplasia develops as a side effect of cyclosporin (see ADVERSE EFFECTS). As nifedipine and

amlodipine can cause gingival hyperplasia it is advised that nifedipine should be avoided in patients who develop gingival hypertrophy under cyclosporin.

### **Corticosteroids**

It has been found that prednisolone clearance is reduced in patients treated with cyclosporin and that plasma levels of cyclosporin increase following the administration of high-dose methylprednisolone.

### **Digoxin**

Cyclosporin may reduce the clearance of digoxin, thereby causing digoxin toxicity. Severe digitalis toxicity has been seen within days of starting cyclosporin in several patients taking digoxin. The concomitant use of digoxin with cyclosporin should be carefully considered. If co-administration is necessary, close clinical observation is required in order to enable early detection of toxic manifestations of the drug, followed by reduction in dosage or drug withdrawal.

### **Colchicine, HMG-CoA reductase inhibitors, Etoposide**

Cyclosporin may also reduce the clearance of colchicine and HMG-CoA reductase inhibitors (statins) and etoposide, thereby enhancing the potential of these drugs to induce muscular toxicity, including muscle pain and weakness, myositis and occasionally rhabdomyolysis. There are reports on the potential of cyclosporin to enhance the toxic effects of colchicine such as myopathy and neuropathy, especially in patients with renal dysfunction. Literature and postmarketing cases of myotoxicity, including muscle pain and weakness, myositis, and rhabdomyolysis, have been reported with concomitant administration of cyclosporin with lovastatin, simvastatin, atorvastatin, pravastatin and, rarely, fluvastatin. The concomitant use of these drugs with cyclosporin should be carefully considered. If co-administration is necessary, close clinical observation is required in order to enable early detection of toxic manifestations of the drug, followed by reduction in dosage or drug withdrawal. When concurrently administered with cyclosporin, the dosage of statins should be reduced according to label recommendations. Statin therapy needs to be temporarily withheld or discontinued in patients with signs and symptoms of myopathy or those with risk factors predisposing to severe renal injury, including renal failure, secondary to rhabdomyolysis.

### **Non-steroidal anti-inflammatory drugs (NSAIDs)**

As non-steroidal anti-inflammatory drugs alone can have an adverse effect on renal function, addition of these drugs to cyclosporin therapy or an increase in their dosage should initially be accompanied by particularly close monitoring of renal function. The concomitant use of diclofenac was found to result in a significant increase in the bioavailability of diclofenac, with a possible consequence of reversible renal function impairment. The increase in bioavailability of diclofenac is most probably caused by a reduction of its first-pass metabolism. If diclofenac is started during cyclosporin therapy, a dose of diclofenac at the lower end of the therapeutic range should be used initially. For most non-steroidal anti-inflammatory drugs there is a lack of direct data on whether or not they interact with cyclosporin. However, if non-steroidal anti-inflammatory drugs with low first-pass effect (eg. aspirin) are given together with cyclosporin, no increase in their bioavailability is expected.

### **Recombinant human erythropoietin (rhEPO)**

As both recombinant human erythropoietin and cyclosporin are reported to increase blood pressure in a significant number of patients, caution should be exercised when administering these agents concomitantly.

## Repaglinide

Cyclosporin may increase the plasma concentrations of repaglinide and thereby increase the risk of hypoglycaemia.

### CYCLOSPORIN: SUBSTANTIATED DRUG INTERACTIONS

<b>Agents increasing Cyclosporin Blood Concentrations</b>	<b>Drugs decreasing Cyclosporin Blood Concentrations</b>	<b>Drugs causing additive nephrotoxicity</b>	<b>Miscellaneous (Described Effect)</b>
Allopurinol Amiodarone Azole antifungals (e.g. fluconazole, itraconazole, ketoconazole) Cholic acid + derivatives Colchicine Danazol Diltiazem Doxycycline Grapefruit juice Imatinib Macrolide antibiotics (e.g. clarithromycin, azithromycin, erythromycin) Metoclopramide Methylprednisolone (high-dose) Nefazodone Nicardipine Oral Contraceptives Levonorgestrel Norethisterone Protease inhibitors Verapamil Voriconazole	Barbiturates (e.g. phenobarbitone) Bosentan Carbamazepine Ciprofloxacin Isoniazid Octreotide Orlistat Oxcarbazepine Phenytoin Probucol Rifampicin St John's wort ( <i>Hypericum perforatum</i> ) Sulfinpyrazone Sulphadimidine + trimethoprim i.v. Terbinafine	Aminoglycosides (e.g. gentamicin, tobramycin) Amphotericin B Ciprofloxacin Colchicine Histamine H <sub>2</sub> -receptor antagonists (e.g. cimetidine, ranitidine) Melphalan Methotrexate NSAIDs (e.g. diclofenac, indomethacin, naproxen, sulindac) Trimethoprim (including trimethoprim plus sulphamethoxazole) Vancomycin	Nifedipine and amlodipine (gingival hyperplasia) Prednisolone (↓ prednisolone clearance)

**CYCLOSPORIN: SUSPECTED OR POTENTIAL INTERACTIONS**

**Include the following:**

<b>Drugs Increasing Cyclosporin Blood Concentrations</b>	<b>Drugs Decreasing Cyclosporin Blood Concentrations</b>	<b>Drugs Causing Additive Nephrotoxicity</b>
Androgenic steroids Methyltestosterone Cephalosporins Ceftazidime Latamoxef Ethanol (heavy intake) H <sub>2</sub> antagonists Cimetidine Ranitidine Imipenem/cilastatin Norfloxacin Oral anticoagulants Warfarin Thiazide Diuretics Ticarcillin	Anticonvulsants Primidone Metoprolol Omeprazole Somatostatin analogues Ticlopidine	Aciclovir Ganciclovir Doxorubicin Cephalosporins Ceftazidime Digoxin Disopyramide Diuretics Metolazone Frusemide

**ADVERSE EFFECTS**

The following adverse reactions have been observed with Sandimmun. They are usually dose-dependent and responsive to dose reduction.

Evidence of renal or hepatic dysfunction warrants close monitoring of blood levels and possibly reduction in dose. In the various indications, the overall spectrum of side effects is essentially the same. However, there are differences in incidence and severity. As a consequence of the higher initial doses and longer maintenance therapy required after transplantation, side effects are more frequent in transplant patients than in patients treated for other indications.

Anaphylactoid reactions have been observed following i.v. administration (see PRECAUTIONS).

**Infections and Infestations:**

Patients receiving immunosuppressive therapies, including cyclosporin and cyclosporin-containing regimens, are at increased risk of infections (viral, bacterial, fungal, parasitic) (see PRECAUTIONS). Both generalised and localised infections can occur. Pre-existing infections may also be aggravated and reactivation of Polyomavirus infections may lead to Polyomavirus associated nephropathy (PVAN) or to JC virus associated progressive multifocal leukoencephalopathy (PML). Serious and/or fatal outcomes have been reported.

**Neoplasms benign, malignant and unspecified (including cysts and polyps):**

Patients receiving immunosuppressive therapies, including cyclosporin and cyclosporin-containing regimens, are at increased risk of developing lymphomas or lymphoproliferative disorders and other malignancies, particularly of the skin. The frequency of malignancies increases with the intensity and duration of therapy (see PRECAUTIONS). Some

malignancies may be fatal.

### **Tabulated summary of adverse drug reactions**

The adverse reactions (Table 1) are listed by MEDRA system organ class. Within each class, the adverse drug reactions are ranked by frequency, with the most frequent reactions first. Within each frequency grouping, adverse drug reactions are presented in order of decreasing seriousness. In addition the corresponding frequency category for each adverse drug reaction is based, using the following convention (CIOMS III):

Very common	≥ 10%
Common	≥ 1% and < 10%
Uncommon	≥ 0.1% and < 1%
Rare	≥ 0.01% and < 0.1%
Very rare	< 0.01%

### **Table 1: Adverse reactions from clinical trials**

#### **Metabolism and nutrition disorders:**

<u>Very Common:</u>	hyperlipidaemia
<u>Common:</u>	anorexia, hyperkalaemia, hyperuricaemia, hypomagnesaemia
<u>Rare:</u>	hyperglycaemia

#### **General disorders and administration site conditions:**

<u>Common:</u>	pyrexia, fluid retention/oedema, weight increase
<u>Uncommon:</u>	weight loss, hyperthermia

#### **Vascular disorders:**

<u>Very common:</u>	hypertension (see PRECAUTIONS)
<u>Common:</u>	flushing
<u>Rare:</u>	hypertension with fluid retention and convulsions, mainly in children

#### **Nervous system disorders:**

<u>Very common:</u>	tremor, fatigue, burning sensation in hands and feet (usually during the first week of treatment), headache including migraine
<u>Common:</u>	paraesthesiae, convulsions
<u>Uncommon:</u>	confusion, lethargy, depression, disorientation, decreased responsiveness, agitation, insomnia, cortical blindness, visual hallucinations, encephalopathy including Posterior Reversible Encephalopathy Syndrome (PRES), vision and movement disturbances, impaired consciousness, coma, paresis, cerebellar ataxia
<u>Rare:</u>	motor polyneuropathy
<u>Very rare:</u>	optic disc oedema including papilloedema, with possible visual impairment, secondary to benign intracranial hypertension

#### **Skin and subcutaneous tissue disorders:**

<u>Very common:</u>	hirsutism (hypertrichosis)
<u>Common:</u>	acne, skin rash of possible allergic origin
<u>Uncommon:</u>	itchiness
<u>Rare:</u>	burning sensation, pigmentation

**Reproductive system and breast disorders:**

Common: reversible dysmenorrhoea or amenorrhoea

Uncommon: gynaecomastia

**Gastrointestinal disorders:**

Very common: gingival hypertrophy (gingival hyperplasia), gastrointestinal disturbances (nausea, vomiting, diarrhoea, abdominal pain or discomfort)

Common: acute pancreatitis, peptic ulcer

Rare: gastroenteritis, asymptomatic hyperamylasemia, biliary calculous disease

associated with moderate or severe hepatotoxicity

**Blood and lymphatic system disorders:**

Common: leukopenia increased susceptibility to infections, anaemia

Uncommon: thrombocytopenia

Rare: malignancies, lymphoproliferative disorders, micro-angiopathic haemolytic anaemia, haemolytic uraemic syndrome (thrombocytopenia, sometimes associated with micro-angiopathic haemolytic anaemia and renal failure, which may result in graft failure)

**Hepatobiliary disorders:**

Very common: hepatic function abnormal (see PRECAUTIONS)

**Musculoskeletal and connective tissue disorders:**

Common: muscle cramps, myalgia

Rare: muscle weakness, myopathy

**Renal and urinary disorders:**

Very common: impaired renal function (see PRECAUTIONS)

**Respiratory, thoracic and mediastinal disorders:**

Rare: sinusitis, adult respiratory distress syndrome

**Ear and labyrinth disorders:**

Uncommon: hearing loss, tinnitus

**Long-Term Safety Monitoring**

Data on Sandimmun-treated transplant recipients monitored in long-term safety follow-up studies indicate that the occurrence of most adverse events is dose dependent and that their manifestation can be minimised by giving the lowest effective dose of Sandimmun.

**Post-marketing Experience**

In addition to the adverse events reported in the clinical trials, the following adverse reactions (Table 2) have been reported in post-marketing surveillance. These adverse drug reactions are obtained from spontaneous case reports and literature cases. Because these reactions are reported voluntarily from a population of uncertain size, it is not possible to reliably estimate their frequency, which is therefore categorized as frequency not known.

**Table 2: Adverse reactions from post-marketing experience**

Frequency not known

<b>General disorders and administration site conditions:</b>	Fatigue, weight gain
<b>Nervous system disorders:</b>	Encephalopathy including Posterior Reversible Encephalopathy Syndrome (PRES), signs and symptoms such as convulsions, confusion, disorientation, decreased responsiveness, agitation, insomnia, visual disturbances, cortical blindness, coma, paresis, cerebellar ataxia, optic disc oedema including papilledema, with possible visual impairment secondary to benign intracranial hypertension, peripheral neuropathy, migraine
<b>Blood and lymphatic system disorders:</b>	Thrombotic microangiopathy, haemolytic uremic syndrome, thrombotic thrombocytopenic purpura, anaemia, thrombocytopenia
<b>Hepatobiliary disorders:</b>	Hepatotoxicity and liver injury* including cholestasis, jaundice, hepatitis and liver failure, with some fatal outcomes (see PRECAUTIONS)
<b>Musculoskeletal and connective tissue disorders:</b>	Myopathy, muscle spasm, , myalgia, muscle weakness, pain of lower extremities*
<b>Renal and urinary disorders:</b>	Nephrotoxicity*
<b>Metabolism and nutrition disorders:</b>	Hyperlipidaemia, hyperuricaemia, hyperkalaemia, hypomagnesaemia
<b>Gastrointestinal disorders</b>	Pancreatitis acute
<b>Skin and subcutaneous disorders</b>	Hypertrichosis
<b>Reproductive system and breast disorders</b>	Gynecomastia

\* More detailed explanations are given below

Hepatotoxicity and liver injury

There have been solicited and spontaneous postmarketing reports of hepatotoxicity and liver injury including cholestasis, jaundice, hepatitis and liver failure in patients with cyclosporin. Most reports included patients with significant co-morbidities, underlying conditions and other confounding factors including infectious complications and comedications with

hepatotoxicity potential. In some cases, mainly in transplant patients, fatal outcomes have been reported (see PRECAUTIONS).

#### Acute and chronic nephrotoxicity

Patients receiving calcineurin inhibitors (CNIs) therapies, including cyclosporin and cyclosporin-containing regimens are at increased risk of acute or chronic nephrotoxicity. There have been reports from clinical trials and from the post marketing setting associated with the use of Sandimmun. Cases of acute nephrotoxicity reported disorders of ion homeostasis, such as hyperkalemia, hypomagnesemia, hyperuricemia. Cases reporting chronic morphological changes included arteriolar hyalinosis, tubular atrophy and interstitial fibrosis (see PRECAUTIONS).

#### Pain of lower extremities

Isolated cases of pain in lower extremities have been reported in association with cyclosporine. Pain of lower extremities has also been noted as part of Calcineurin-Inhibitor Induced Pain Syndrome (CIPS) as described in literature.

## **DOSAGE AND ADMINISTRATION**

Sandimmun capsules should be swallowed whole.

### **Conversion between oral cyclosporin formulations**

Switching from one oral cyclosporin formulation to another should be made with caution and under physician supervision. The introduction of the new formulation must be made with monitoring of blood levels of cyclosporin to ensure that pre-conversion levels are attained.

The dose ranges given below for oral and intravenous administration are intended to serve as guidelines only.

### **Organ Transplantation**

#### Oral solution and capsules:

To initiate treatment, a single oral dose of 10-15 mg/kg should be given 4-12 hours prior to transplantation. This dose is maintained for one to two weeks post-operatively before being gradually reduced until a maintenance dose of about 2-6 mg/kg per day is reached. Routine monitoring of cyclosporin blood levels is required (see DOSAGE AND ADMINISTRATION - Clinical Blood Level Monitoring). The results obtained will serve as a guide for determining the actual dosage required in individual patients.

When Sandimmun is given together with other immunosuppressants (e.g. with corticosteroids or as part of a triple or quadruple drug therapy) lower doses may be used. Some renal transplant patients may need less than 5 mg/kg per day even at one month after transplantation when Sandimmun is given together with corticosteroids.

The total daily amount can be given in a single dose but preferably in two divided doses.

#### Concentrate for intravenous infusion:

Because of the risk of anaphylaxis, the concentrate for infusion should be reserved for patients who are unable to take the drug orally. In such cases it is recommended to change to oral administration as soon as feasible after surgery. The concentrate should be diluted 1:20 to 1:100 with normal saline or 5% glucose and given as a slow intravenous infusion over approximately 2 to 6 hours.

For the initiation of treatment if oral therapy is unacceptable the recommended dosage is 3-5 mg/kg per day, which should be commenced 4-12 hours prior to transplantation.

During episodes of gastrointestinal disturbances which might impair absorption of orally administered Sandimmun, one third of the previously administered oral dose should be given intravenously.

### **Paediatric**

Experience with cyclosporin in young children is limited. Children from one year of age have received the drug in standard dosage. In several studies paediatric patients required and tolerated higher doses of Sandimmun per kg body weight than those used in adults.

### **Nephrotic Syndrome**

**For inducing remission**, the recommended dose is 5 mg/kg per day for adults and 6 mg/kg per day for children if, with the exception of proteinuria, renal function is normal. In patients with impaired renal function, the initial dose should not exceed 2.5 mg/kg per day (see also CONTRAINDICATIONS).

The combination of Sandimmun with low doses of oral corticosteroids has been used by some practitioners, but data on this combination are insufficient at present to allow a recommendation for such use to be made.

If no improvement has been observed after 3 months treatment, Sandimmun therapy should be discontinued.

The doses need to be adjusted individually according to efficacy (proteinuria) and safety (primarily serum creatinine), but should not exceed 5 mg/kg per day in adults and 6 mg/kg per day in children.

**For maintenance treatment**, the dose should be slowly reduced to the lowest effective level.

### **Rheumatoid Arthritis**

**For the first 6 weeks of treatment** the recommended dose is 3 mg/kg per day orally given in two divided doses. To achieve full effectiveness, up to 12 weeks of Sandimmun therapy may be required. However, if there is no clinical response in 4 to 8 weeks, the dose of Sandimmun can be increased at 1 to 2 months intervals by 0.5 to 1.0 mg/kg per day up to a maximum dose of 5.0 mg/kg per day.

**For maintenance treatment** the dose has to be titrated individually according to tolerability. If a patient is on an effective maximum tolerable dose with no further improvements expected, and has been stable for at least 3 months, the dose of Sandimmun should be decreased at 0.5 mg/kg per day increments monthly or bimonthly to the lowest effective dose.

If there is essentially no clinical response by 6 months, and the maximal tolerable dose has been administered for 3 months, Sandimmun should be discontinued. (After 3 months of Sandimmun therapy without response, blood levels monitoring of cyclosporin may be of value to evaluate patient compliance and/or drug absorption.)

**Dose adjustment based on creatinine values:** if the serum creatinine remains increased by more than 30% above baseline at more than one measurement, the dosage of Sandimmun should be reduced. If the serum creatinine increases by more than 50%, a dosage reduction by 50% is mandatory. These recommendations apply even if the patient's values still lie within the laboratory's normal range. If the dose reduction is not successful in reducing levels within one month, Sandimmun treatment should be discontinued.

See INTERACTIONS WITH OTHER MEDICINES for information on the concomitant use of Sandimmun and non-steroidal anti-inflammatory drugs.

## **Psoriasis**

**For inducing remission**, the recommended initial dose is 2.5 mg/kg per day orally given in two divided doses. If there is no improvement after one month, the daily dose may be increased gradually, but should not exceed 5 mg/kg. Treatment should be discontinued in patients in whom sufficient response of psoriatic lesions cannot be achieved within six weeks on 5 mg/kg per day, or in whom the effective dose is not compatible with the safety guidelines (see PRECAUTIONS).

An initial dose of 5 mg/kg per day is justified in patients whose condition requires rapid improvement.

**For maintenance treatment**, doses have to be titrated individually to the lowest effective level, and should not exceed 5 mg/kg per day.

The benefits of treatment can only be expected to continue while treatment is being given.

## **Atopic Dermatitis**

Due to the variability of this condition, treatment must be individualised. The recommended dose range is 2.5 to 5 mg/kg per day given in two divided oral doses. If a starting dose of 2.5 mg/kg per day does not achieve a satisfactory response within two weeks of therapy, the daily dose may be rapidly increased to a maximum of 5 mg/kg. In very severe cases, rapid and adequate control of the disease is more likely to occur with a starting dose of 5 mg/kg per day. Once a satisfactory response is achieved, the dose should be reduced gradually and, if possible, Sandimmun should be discontinued. Subsequent relapse may be managed with a further course of Sandimmun.

Although a course of 8 weeks' therapy may be sufficient to achieve clearing, up to one year's therapy has been shown to be effective and well tolerated, provided the monitoring guidelines are followed.

## **Pharmaceutical Recommendations**

### **Administration of oral solution:**

The oral solution is provided with two syringes for measuring the doses. The 1-mL syringe is used to measure doses less than or equal to 1 mL (each graduation of 0.05 mL corresponds to 5 mg of cyclosporin). The 4-mL syringe is used to measure doses greater than 1 mL and up to 4 mL (each graduation of 0.1 mL corresponds to 10 mg of cyclosporin).

Once dispensed the oral solution should be diluted in a glass (not a plastic) container with milk or chocolate milk and stirred well immediately before being taken. The container should be rinsed with more milk to ensure that the total dose is taken.

For full instructions on administration of oral solution, see Package Insert.

After use, dry the outside of the syringe with a clean paper handkerchief and replace it in the protective case. The oral solution should not be refrigerated. The syringe should not be rinsed with water, alcohol or any other liquid.

Once the bottle has been opened, the contents must be used for no longer than two months.

### **Administration of concentrate for intravenous infusion:**

If available, glass containers should be used. Polyoxyethylated castor oil contained in the concentrate for infusion can cause phthalate stripping from PVC. Containers and stoppers should be free of silicone oil and fatty substances.

Diluted infusion solutions must be discarded after 48 hours.

### **Clinical Blood Level Monitoring**

The monitoring of cyclosporin blood concentration is of value in the management of patient dosage. It must be remembered, however, that the concentration of cyclosporin in the blood is only one of many factors contributing to the clinical status of the patient (see PRECAUTIONS). Results should therefore serve only as a guide to dosing in the context of other clinical and laboratory parameters.

Detailed recommendations on therapeutic monitoring of cyclosporin in transplantation are presented in the paper by Morris RG, Tett SE and Ray JE entitled "Cyclosporin A Monitoring in Australia: Consensus Recommendations" (Ther Drug Monit 1994; 16: 570-576). The general consensus outlined in this paper is that cyclosporin parent drug concentrations be measured only in whole blood using an analytical technique exhibiting minimal or no cross reactivity with cyclosporin metabolites. The blood sample should be taken immediately before the next cyclosporin dose and the blood collection time recorded and standardised to prior to either the morning or evening dose.

Usually routine monitoring of cyclosporin blood levels need not be performed in patients receiving cyclosporin for non-transplant indications. However, monitoring may be indicated in some patients; for example, where there is unexpected treatment failure or relapse, where patients may be at high risk of an adverse reaction or a drug interaction involving Sandimmun, or where there is an urgent need to establish cyclosporin exposure, for example in some life-threatening situations.

## **OVERDOSAGE**

### **Symptoms**

Experience with acute overdosage with oral cyclosporin is limited. Children up to the age of 4 years who had taken oral doses of up to 600 mg, and adults who had taken oral doses of up to 10 g (about 150 mg/kg), presented with only transient, non-serious adverse effects such as hypertension, increased serum creatinine, abnormal liver function test results and gastrointestinal disorders. A serious event has, however, been reported in a 11-year old liver transplant recipient who experienced a seizure associated with hypomagnesaemia following an oral dose of cyclosporin of 2600 mg.

Serious symptoms of intoxication have been reported following accidental parenteral overdosage with cyclosporin in premature neonates.

### **Treatment**

If indicated, symptomatic treatment and general supportive measures should be followed in cases of overdosage. Cyclosporin is not dialysable to any great extent nor is it cleared well by charcoal haemoperfusion.

Contact the Poisons Information Centre on 13 11 26 for advice on management.

## **PRESENTATIONS AND STORAGE CONDITIONS**

### **Presentations**

#### **Oral solution**

100 mg/mL: Yellow to brownish liquid; clear, or a small amount of very fine sediment; bottles of 50 mL, with 1 mL and 4 mL dose dispensers\*

**Capsules**

- 25 mg: Pink oval soft gelatin capsule, approx. 11.3 mm (length) and 7.4 mm (diameter); blister packs of 50 capsules\*
- 50 mg: Corn yellow, oblong, soft, gelatin capsule, approx 19.9 mm (length) and 7.5mm (diameter); blister packs of 50 capsules\*.
- 100 mg: Dusty rose oblong soft gelatin capsule, approx. 24.9 mm (length) and 8.7 mm (diameter); blister packs of 50 capsules\*

**Concentrate for intravenous infusion**

- 250 mg/5 mL: Clear brown-yellow, oily solution; packs of 10 x 5 mL ampoules
- 50 mg/1 mL: Clear brown-yellow, oily solution; packs of 10 x 1 mL ampoules

\* Not all presentations are available

**Storage conditions**

- Oral solution:** Store below 25°C. Do not refrigerate.
- Capsules:** Store below 30°C
- Concentrate for infusion:** Store below 30°C.

**POISON SCHEDULE**

Schedule 4

**SPONSOR**

NOVARTIS Pharmaceuticals Australia Pty Limited  
 ABN 18 004 244 160  
 54 Waterloo Road  
 NORTH RYDE NSW 2113

**ARTG START DATES**

- 21 Aug 1991: SANDIMMUN cyclosporin 100 mg capsule blister pack (AUST R 13341)
- 21 Aug 1991: SANDIMMUN cyclosporin 25 mg capsule blister pack (AUST R 13342)
- 21 Aug 1991: SANDIMMUN cyclosporin 50 mg/1mL injection ampoule (AUST R 13370)
- 15 Feb 1993: SANDIMMUN cyclosporin 50 mg capsule, blister pack (AUST R 40690)
- 15 Jun 1993: SANDIMMUN cyclosporin 100 mg/mL drink solution oral liquid bottle (AUST R 42686)
- 6 Dec 1993: SANDIMMUN cyclosporin 250 mg/5mL injection ampoule (AUST R 47290)

**DATE OF MOST RECENT AMENDMENT**

4 November 2014

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(sim041114i.doc) based on BPI of 5 August 2014