Product Information

METRONIDAZOLE INTRAVENOUS INFUSION

Name of the medicine
Metronidazole.

The structural formula is represented below.

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\begin{align*}
\text{CH}_2\text{CH}_2\text{OH} \\
\text{O}_2\text{N} \\
\text{N} \\
\text{Me}
\end{align*}
\]

Molecular Formula: \( \text{C}_6\text{H}_9\text{N}_3\text{O}_3 \)
Molecular Weight: 171.2
CAS Number: 443-48-1

Description
Metronidazole is 2-(5-nitro-2-methylimidazol-1-yl)ethanol. It is a white or yellowish, crystalline powder, slightly soluble in water, in acetone, in alcohol and in methylene chloride and very slightly soluble in ether.

Metronidazole Intravenous Infusion is an almost colourless to pale yellow, sterile, isotonic, preservative-free, ready to use solution containing Metronidazole BP 5mg/mL, Citric Acid BP 0.36mg/mL, sodium phosphate-dibasic anhydrous 0.6mg/mL and Sodium Chloride BP 7.4mg/mL in Water for Injections BP. Each mL contains 0.135mmoles sodium.

Pharmacology

Class: Antimicrobial agent.

Microbiology: Metronidazole is active \textit{in vitro} against anaerobic bacteria and as an antiprotozoal agent. It does not appear to possess any clinically relevant activity against facultative anaerobes or obligate aerobes. Against susceptible organisms, metronidazole is generally bactericidal at concentrations equal to or slightly higher than the minimal inhibitory concentrations (MIC).

Metronidazole has been shown to have \textit{in vitro} activity against many anaerobic gram-negative bacilli including \textit{Bacteroides fragilis} and other \textit{Bacteroides} sp., \textit{Fusobacterium}, \textit{Eubacterium}, \textit{Clostridium} and anaerobic \textit{Streptococci}. Metronidazole is also active against a wide range of pathogenic protozoa including \textit{Trichomonas vaginalis} and other trichomonads, \textit{Entamoeba histolytica}, \textit{Giardia lamblia}, \textit{Balantidium coli} and the causative organisms of active ulcerative gingivitis.

Susceptibility tests

Dilution or diffusion techniques - either quantitative (MIC) or breakpoint, should be used following a regularly updated, recognised and standardised method (e.g. National Committee for Clinical Laboratory Standards). Standardised susceptibility test procedures require the use of laboratory control microorganisms to control the technical aspects of the laboratory procedures.

A report of “Susceptible” indicates that the pathogen is likely to be inhibited if the antimicrobial compound in the blood reaches the concentrations usually achievable. A report of “Intermediate” indicates that the result should be considered equivocal, and if the microorganism is not fully susceptible to alternative, clinically feasible drugs, the test should be repeated. This category implies possible clinical applicability in body sites where the drug is physiologically concentrated or in situations where high dosage of drug can be used. This category also provides a buffer zone, which prevents small uncontrolled technical factors from causing major discrepancies in interpretation. A report of “Resistant” indicates that the pathogen is not likely to be inhibited if the antimicrobial compound in the blood reaches the concentrations usually achievable; other therapy should be selected.
Note: The prevalence of resistance may vary geographically for selected species and local information on resistance is desirable, particularly when treating severe infections.

Pharmacokinetics:
Note: Polarographic estimation of metronidazole in serum or urine tends to give higher values than microbiological assay because the former measures both unchanged drug and metabolites. Erroneously high serum values may be obtained in the presence of severe renal failure because of the retention of metabolites in the blood.

Absorption: Following intravenous infusion, peak plasma levels of metronidazole occur at the end of the infusion.

Distribution: Metronidazole is distributed widely throughout body tissues both intracellularly and extracellularly. It is found in saliva and breast milk in concentrations equivalent to those in plasma. It also crosses the placenta and is found in the CSF. Therapeutic levels have been found in abscesses, bile, CSF, seminal fluid and in synovial fluid.

Protein binding: There is no significant plasma protein binding of metronidazole.

Metabolism: Metronidazole is partly metabolised in the liver by both acid oxidation and glucuronide conjugation. The principal metabolites are the hydroxy metabolite (1-(2-hydroxyethyl)-2-hydroxymethyl-5-nitroimidazole) and the acid metabolite (1-acetic acid-2-methyl-5-nitroimidazole). The hydroxy metabolite has approximately 30% of the bioactivity of metronidazole against anaerobic bacteria whereas the acid metabolite has only 5% of the activity of unchanged metronidazole.

Excretion: About 15 to 20% of an administered dose is excreted in the urine as unchanged metronidazole. Overall, about 50-80% of an administered dose is excreted as nitro-containing compounds, of which unchanged metronidazole and the hydroxymethyl homologue each account for about one third. The fate of the remainder of an administered dose is unknown. Metronidazole is also excreted into saliva and breast milk reaching concentrations equivalent to those in plasma.

Half life: The half life of metronidazole after single, intravenous infusion has been reported as 7.3 ± 1.0 hours.

Indications
• treatment of severe anaerobic infection when oral medication is not possible or is contraindicated, when immediate anti-anaerobic therapy is required
• metronidazole may be used prophylactically to prevent infection of the surgical site which may have been contaminated or potentially contaminated with anaerobic organisms. Procedures in which this may be assumed to have happened include appendectomy, colonic surgery, vaginal hysterectomy, abdominal surgery in the presence of anaerobes in the peritoneal cavity and surgery performed in the presence of anaerobic septicaemia

Contraindications
• patients with a history of a blood dyscrasias should not receive the drug since occasionally leucopenia has been observed during its administration
• active organic disease of the central nervous system
• hypersensitivity to metronidazole or other nitroimidazoles

Precautions
• Long term therapy: If metronidazole is to be administered for more than 10 days, it is recommended that haematological tests, especially total and differential leukocyte counts, be carried out regularly and that patients be monitored for adverse reactions such as peripheral neuropathy. If leucopenia or abnormal neurological signs occur, the drug should be discontinued immediately.
• Cardiac function impairment: Care should be taken because of the sodium content (0.135mmol/mL) in this dosage form.
• **Sodium retention:** Administration of solutions containing sodium ions may result in sodium retention. Care should be taken when administering Metronidazole Intravenous Infusion to patients receiving corticosteroids or patients predisposed to oedema.

• **Central nervous system:** Convulsive seizures and peripheral neuropathy characterised mainly by numbness or paraesthesia of an extremity have been reported. The appearance of abnormal neurological signs demands the prompt evaluation of the benefit/risk ratio of the continuation of therapy. Metronidazole should be used with caution in patients with active or chronic severe peripheral or central nervous system diseases due to the risk of neurological damage. Patients should be warned about the potential for confusion, dizziness, hallucinations, convulsions or transient visual disorders.

• **Severe hepatic disease:** Patients with severe hepatic disease metabolise metronidazole slowly, with resultant accumulation of metronidazole and its metabolites in the plasma. Accordingly, for such patients, doses below those usually recommended should be administered cautiously.

• **Interference with clinical, laboratory and other tests:** Metronidazole may show negative interference with continuous flow spectrophotometry of aspartate aminotransferase (previously GOT), so that hepatocellular damage which is detectable by raised serum AST may be missed. Metronidazole may interfere with AST, ALT, LDH, triglycerides or glucose determinations when these are based on the decrease in ultraviolet absorbance which occurs when NADH is oxidised to NAD. Metronidazole interferes with these assays because the drug has an absorbance peak of 322 nanometres at pH 7, which is close to the 340 nanometre absorbance peak of NAD; this causes an increase in absorbance at 340 nanometres resulting in falsely decreased values.

• **Candidiasis:** Candida overgrowth in the gastrointestinal or genital tract may occur during metronidazole therapy and may require treatment with a candidicidal drug.

• **Surgical drainage:** Use of metronidazole does not obviate the need for aspiration of pus whenever indicated, such as in amoebic hepatic abscess or abscesses in other inaccessible positions.

**Instructions to be given to patients**
- patients should be warned to refrain from consumption of alcohol whilst taking metronidazole
- patients should be advised to report any signs of toxicity, especially neurological disturbances, to the doctor
- patients should be warned about the possibility of their urine darkening in colour

**Carcinogenesis, mutagenesis, impairment of fertility:** **Mutagenesis, tumorigenesis:** Metronidazole has been found to be mutagenic in bacteria and some animal species. In studies on the mutagenic potential of metronidazole, the Ames mutagenicity test was positive while several nonbacterial tests in animals were negative. In patients suffering from Crohn's disease, metronidazole increased chromosome abnormalities. In addition, the drug has been shown to be tumorigenic in rodents. The benefit/risk ratio should therefore be carefully assessed in each case, particularly in relation to the severity of the disease and the age of the patient.

**Carcinogenesis:** Metronidazole has shown evidence of tumorigenic activity in a number of studies involving chronic oral administration in mice and rats. Most prominent among the effects in the mouse was the promotion of pulmonary tumorigenesis. This has been observed in multiple studies in that species, including one study in which the animals were dosed on an intermittent schedule (administration during every fourth week only). The published results of one of the mouse studies indicated an increase in the incidence of malignant lymphomas as well as pulmonary neoplasms associated with lifetime feeding of the drug. All these effects were statistically significant. In the rat, there was a statistically significant increase in the incidence of various neoplasms, particularly mammary tumours, among female rats administered metronidazole over that noted in the concurrent female control groups. Two lifetime tumorigenicity studies in hamsters have been performed and reported to be negative.
Results of a retrospective epidemiological study of 771 women treated with metronidazole for *T. vaginalis* have not revealed any statistically significant increase in cancer incidence over that expected in the normal population. The apparent increase in cervical carcinoma *in situ* in the metronidazole treated group was no different from the incidence in women documented to have had trichomoniasis not treated by metronidazole. Because of the limitations of a relatively small retrospective study, these results do not provide definite answers and the risk of carcinogenicity emphasises the need to avoid indiscriminate use of the drug.

**Use in pregnancy: Category B2:** Metronidazole should not be given in the first trimester of pregnancy as it crosses the placenta and enters fetal circulation rapidly. Although it has not been shown to be teratogenic in either human or animal studies, such a possibility cannot be excluded. In addition, the drug has been shown to be tumorigenic in rodents as well as mutagenic *in vitro* and in some animal studies. It is therefore recommended that the drug's use for trichomoniasis in the 2nd and 3rd trimesters of pregnancy be restricted to those in whom local palliative treatment has been inadequate to control symptoms. In life threatening situations the benefit/risk ratio should be carefully considered.

There is some evidence that the fetal alcohol syndrome may be due to small quantities of acetaldehyde rather than alcohol. If this is the case then metronidazole should not be taken in association with alcohol by pregnant women. Metronidazole inhibits aldehyde dehydrogenase thereby permitting accumulation of acetaldehyde which is one of the breakdown products of ethanol.

**Use in lactation:** Metronidazole is secreted in breast milk. In view of the tumorigenic and mutagenic potential of metronidazole, breast feeding is not recommended.

**Interactions with other drugs:**
- **Alcohol:** Metronidazole taken in combination with alcohol may produce abdominal cramps, nausea, vomiting, headaches and flushing. Patients should be advised not to take alcohol during therapy or for at least one day afterwards because of the possibility of a disulfiram-like reaction.
- **Disulfiram:** In a clinical trial of combined therapy with disulfiram and metronidazole in the treatment of chronic alcoholics, severe acute psychotic reactions occurred in 6 out of 29 patients. Psychotic reactions have been reported in alcohol dependent patients who are receiving metronidazole and disulfiram concurrently. Metronidazole should not be given to patients who have taken disulfiram in the previous two weeks.
- **Warfarin and other coumarin anticoagulants:** Metronidazole has been reported to potentiate the anticoagulant effect of oral anticoagulants, resulting in prolongation of the prothrombin time. Concurrent administration should be avoided if possible. If metronidazole is used in patients receiving an oral anticoagulant, prothrombin time should be monitored and the dosage of the anticoagulant adjusted accordingly.
- **Cyclophosphamide and BCNU (Carmustine):** Metronidazole should be used with caution in patients who are receiving BCNU or cyclophosphamide as a drug interaction shown in mice leads to increased toxicity.
- **Phenobarbital and phenytoin:** The simultaneous administration of drugs that induce microsomal hepatic enzyme activity, such as phenobarbitone, pentobarbitone or phenytoin, may accelerate the elimination of metronidazole, resulting in reduced plasma concentrations and increased concentrations of its 2-hydroxymethyl metabolite. Impaired clearance of phenytoin has also been reported.
- **Lithium:** Initiation of short-term metronidazole therapy in patients stabilised on relatively high dosages of lithium has been reported to increase serum lithium concentrations, resulting in signs of lithium toxicity in several patients. Serum lithium and serum creatinine levels should be obtained several days after beginning metronidazole therapy to detect any increase that may precede clinical symptoms of lithium intoxication.
Cimetidine: The simultaneous administration of drugs that decrease microsomal hepatic enzyme activity, such as cimetidine, may prolong the half-life and decrease the plasma clearance of metronidazole. It is not clear if ranitidine exerts a similar effect.

Corticosteroids: Care should be taken when administering metronidazole infusion to patients receiving corticosteroid therapy or to patients predisposed to oedema since administration of solutions containing sodium ions may result in sodium retention.

Fluorouracil and azathioprine: Transient neutropenia has been reported in twelve patients who received oral and intravenous metronidazole in conjunction with intravenous fluorouracil and in at least one patient who received oral metronidazole in conjunction with azathioprine.

Adverse effects
More common reactions:
- Dermatological: Rash.
- Gastrointestinal: Nausea, anorexia, furry tongue, dry mouth, abdominal discomfort, glossitis, stomatitis (which may be associated with candida overgrowth - see Precautions).
- Nervous System: Metallic or unpleasant taste in the mouth, headaches.

Less common reactions:
- Auditory and vestibular: Vertigo, tinnitus.
- Biochemical abnormalities: Jaundice has been reported in one patient being treated for anaerobic infection.
- Cardiovascular: Flattening of the T wave, prolongation of the QT interval, thrombophlebitis.
- Dermatological: Mild erythematous eruption, pruritus, urticaria and flushing.
- Gastrointestinal: Vomiting, diarrhoea, dyspepsia in patients with anaerobic infections. Patients with Crohn's disease are known to have an increased incidence of gastrointestinal and certain extraintestinal cancers. Rare cases of pancreatitis, which abated on withdrawal of the drug, have been reported. There have been reports of cases of pseudomembranous colitis whilst on metronidazole therapy.
- Genito-urinary: Darkening of urine (possibly due to metabolites). Dysuria, dryness of vagina or vulva, cystitis, a sense of pelvic pressure, very rarely dyspareunia, polyuria, incontinence, decrease in libido, proctitis and pyuria have been reported during metronidazole therapy (although all of these may be attributable to the underlying pathology).
- Haematological and reticuloendothelial: Leucopenia (usually moderate and transient - see Precautions). One case of bone marrow aplasia attributable to metronidazole has been reported. Rarely, reversible thrombocytopenia occurs.
- Musculoskeletal: Joint pains, sometimes resembling "serum sickness".
- Nervous system: Lack of coordination, ataxia, convulsive seizures, confusion, irritability, dizziness, depression, weakness, insomnia, disorientation, peripheral neuropathy, characterised mainly by numbness or paraesthesia of an extremity (see Precautions). Transient vision disorders such as diplopia and myopia have been reported.
- Respiratory: Nasal congestion.

Serious or life threatening reactions:
Leucopenia is usually transient and disappears on withdrawal of the drug. If paraesthesia occurs, the drug should be discontinued and the symptoms usually disappear.

Dosage and administration
Metronidazole Intravenous Infusion contains no microbial agent. It should be used only once and any residue discarded.
A maximum of 4g should not be exceeded during a 24 hour period.
Adult:
Metronidazole should be infused intravenously at the rate of 5mL (25mg) per minute. Metronidazole infusion may be administered alone or concurrently (but separately) with other appropriate antibacterial agents in parenteral dosage forms (see Incompatibility).

For prophylactic use the appropriate dose should be infused shortly before surgery and repeated 8 hourly for the next 24 hours.
The adult dose is 500mg metronidazole (i.e. 100mL) by infusion eight hourly.

Duration of therapy: Treatment for seven days should be satisfactory for most patients but, depending on clinical and bacteriological assessment, the clinician might decide to prolong treatment, e.g. for the eradication of infection from sites which cannot be drained or are liable to endogenous recontamination by anaerobic pathogens from the gut, oropharynx or female genital tract.

Note: Prevention of infection at the surgical site requires that adequate tissue concentrations of the drug should have been achieved at the time of surgery. The dose and route of administration should be selected in each case to achieve this objective.

Oral medication should be substituted as soon as possible.

Paediatric:
Although metronidazole has been used for some years in children, recent evidence concerning mutagenicity and tumorigenicity suggests that caution should be exercised when using metronidazole in this age group.

Children over 12 years: Same dosage as adults.

Children under 12 years: Eight hourly as for adults but the single intravenous dose is based on 7.5mg (1.5mL) metronidazole/kg bodyweight.

Geriatric:
Use adult dosage with care as some degree of impaired hepatic or renal function may be present in elderly patients. In elderly patients, the pharmacokinetics of metronidazole may be altered; therefore monitoring of serum levels may be necessary to adjust the metronidazole dosage accordingly.

With impaired hepatic function: As metronidazole is partly metabolised in the liver, caution should be exercised in patients with impaired liver function. Empirical dosage reduction and serum level monitoring may be necessary.

With impaired renal function: In patients on twice weekly haemodialysis, metronidazole and its major active metabolite are rapidly removed during an 8 hour period of dialysis, so the plasma concentration quickly falls below the therapeutic range. Hence a further dose of metronidazole would be needed after dialysis to restore an adequate plasma concentration. In patients with renal failure the half life of metronidazole is unchanged but those of its major metabolites are prolonged 4-fold or greater. The accumulation of the hydroxy metabolite could be associated with side effects and measurement of its plasma concentrations by high pressure liquid chromatography (HPLC) has been recommended.

While the pharmacokinetics of metronidazole are little changed in the presence of anuria, there is retention of the metabolites, the clinical significance of which is unknown.

Incompatibility: Additives should not be introduced into intravenous metronidazole solutions. If used with a primary intravenous fluid system, the primary solution should be discontinued during metronidazole infusion. Parenteral drugs should be inspected visually for particulate matter and discoloration prior to administration, wherever solution or container permit. Do not use if the solution is cloudy or precipitated or if the seal is not intact.

Additional information: Metronidazole Intravenous Infusion is an isotonic (280mOsm per kg), ready to use solution, requiring no dilution or buffering prior to administration.
The total sodium content (derived from sodium phosphate buffer and sodium chloride) is approximately 13.5mmol (13.5mEq, 310mg) per 100mL of solution. This must be considered in patients on a restricted sodium intake when calculating total daily sodium intake.

**Overdosage**

**Clinical Features:** Overdosage with metronidazole appears to be associated with very few abnormal signs or symptoms. Disorientation, ataxia, nausea and vomiting, peripheral neuropathy and seizures have been reported, especially after ingestion of large amounts.

**Presentation and storage conditions**

AUST R 12728 Metronidazole Intravenous Infusion 500mg in 100mL (sterile) plastic vial.

Store below 25°C. Protect from light.

Single use only. Discard unused portion.

The expiry date (month/year) is stated on the package after EXP.

**Name and address of the sponsor**

**Sponsor in Australia**
Pfizer Australia Pty Ltd
ABN 50 008 422 348
38-42 Wharf Road
West Ryde NSW 2114
Australia

**Manufacturer**
Pfizer (Perth) Pty Limited
ABN 32 051 824 956
15 Brodie Hall Drive,
Bentley WA 6102 Australia

**Poison schedule of the medicine**

Australia - S4.

**Date of approval**

This information was approved by the TGA on 12 December 2001.

**Date of most recent amendment:** 13 August 2010