

AUSTRALIAN PRODUCT INFORMATION – DBL™ ROCURONIUM BROMIDE INJECTION (ROCURONIUM BROMIDE)

1. NAME OF THE MEDICINE

Rocuronium bromide

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

DBL Rocuronium Bromide Injection contains rocuronium bromide 50 mg/5 mL

For the full list of excipients, see Section 6.1 List of excipients.

3. PHARMACEUTICAL FORM

Solution for injection.

DBL Rocuronium Bromide Injection is supplied as a sterile, nonpyrogenic, isotonic solution that is clear, colourless to faintly yellow, administered by intravenous bolus or infusion.

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

DBL Rocuronium Bromide Injection is indicated as an adjunct to general anaesthesia to facilitate endotracheal intubation during routine induction, to provide muscle relaxation and to facilitate mechanical ventilation in adults, children and infants over 1 month of age.

DBL Rocuronium Bromide Injection is also indicated as an adjunct to general anaesthesia to facilitate endotracheal intubation during rapid sequence induction when suxamethonium is contraindicated, however, this has not been studied in infants and in children.

DBL Rocuronium Bromide Injection is also indicated as an adjunct in the Intensive Care Unit to facilitate mechanical ventilation.

4.2 Dose and method of administration

Dosage

Risk of Medication Errors: Accidental administration of neuromuscular blocking agents may result in serious adverse events, including fatal outcomes. Store rocuronium bromide injection with the cap and ferrule intact and in a manner that minimises the possibility of selecting the wrong product (see section 4.4 Special warnings and precautions for use).

Like other neuromuscular blocking agents DBL Rocuronium Bromide Injection should only be administered by, or under supervision of, experienced clinicians who are familiar with the action and use of these drugs.

The product is for single patient use and contains no antimicrobial agent; any residue is required to be discarded.

As with other neuromuscular blocking agents, the dosage of rocuronium bromide should be individualised in each patient. The anaesthetic method used, the duration of surgery, the method of sedation and the expected duration of mechanical ventilation, the possible interaction with other drugs that are administered concomitantly, and the condition of the patient should be taken into account when determining the dose. The use of an appropriate neuromuscular monitoring technique is recommended for evaluation of the neuromuscular block and the recovery.

Inhalation anaesthetics do potentiate the activity of rocuronium. This potentiation, however, becomes clinically relevant in the course of anaesthesia, when the volatile agents have reached the tissue concentrations required for this interaction. Consequently, adjustments with rocuronium bromide should be made by administering smaller maintenance doses at less frequent intervals or by using lower infusion rates of rocuronium bromide during long lasting procedures (longer than one hour) under inhalation anaesthesia (see section 4.5 Interactions with other medicines and other forms of interactions).

In adult patients the following dosage recommendations may serve as a general guideline for tracheal intubation and muscle relaxation for short to long lasting surgical procedures and for use in the intensive care unit. Elderly patients (65 – 80 years) manifest similar sensitivity to rocuronium as younger adults.

Surgical Procedures

Tracheal intubation

The standard intubating dose during routine anaesthesia is 0.6 mg/ kg rocuronium bromide This dose can also be used for facilitating intubation during rapid sequence induction of anaesthesia. However, as part of a rapid sequence induction technique, a dose of 1.0 mg/kg rocuronium bromide is recommended.

Higher doses

Should there be a reason for selection of larger doses in individual patients, initial doses up to rocuronium bromide 2 mg/kg have been administered during surgery without adverse cardiovascular effects being noted. The use of these high dosages of rocuronium decreases the onset time and increases the duration of action (see section 5.1 Pharmacodynamic properties).

Maintenance dose

0.15 mg/kg rocuronium bromide; in the case of long-term inhalational anaesthesia, this should be reduced to 0.075 to 0.1 mg/kg rocuronium bromide. The maintenance doses should best be given when twitch height has recovered to 25% of control twitch height or when two to three responses to train of four stimulation are present.

Continuous infusion

A loading dose of 0.6 mg/kg is recommended. When neuromuscular block starts to recover, the infusion should be started and the rate adjusted to maintain twitch response at 10% of control twitch height or to maintain one to two responses to train of four stimulation.

In adults under intravenous anaesthesia, the infusion rate required to maintain neuromuscular block at this level ranges from 0.3 to 0.6 mg/kg/hour and under inhalational anaesthesia, the infusion rate ranges from 0.3 to 0.4 mg/kg/hour. Continuous monitoring of the degree of blockade is recommended since infusion rate requirements vary from patient to patient and with the anaesthetic method used. A reduction in infusion rate may be required in patients with significant renal and/or hepatic disease.

Paediatric patients

For infants (28 days to 23 months), children (2 to 11 years) and adolescents (12 to 18 years) the recommended intubation dose during routine anaesthesia and maintenance dose are similar to those in adults.

For continuous infusion in paediatrics, the infusion rates, with exception of children, are the same as for adults. For children higher infusion rates might be necessary. For children the same initial infusion rates as for adults are recommended and this should be adjusted to maintain twitch response at 10% of control twitch height or to maintain one or two responses to train of four stimulation during the procedure.

During continuous infusion in paediatric patients, dose and infusion rate must be carefully monitored and adjusted if necessary to allow for age related differences in pharmacokinetics.

There are no data with DBL Rocuronium Bromide Injection to support recommendations for use in neonates (0 to 1 month).

The experience with rocuronium bromide in rapid sequence induction in paediatric patients is limited. Rocuronium bromide is therefore not recommended for facilitating tracheal intubation conditions during rapid sequence induction in paediatric patients.

Dosing in geriatric patients and patients with hepatobiliary disease and/or renal failure

The intubation dose for geriatric patients and patients with hepatic and/or biliary tract disease and/or renal failure is 0.6 mg/kg rocuronium bromide. Regardless of the anaesthetic technique used, the recommended maintenance dose for these patients is 0.075 to 0.1 mg/kg rocuronium bromide and the recommended infusion rate is 0.3 to 0.4 mg/kg/hour (see also section 4.2 Dose and method of administration: Continuous infusion).

Overweight and obese patients

Doses should be adjusted to conform with lean body mass in patients with a weight more than 30% higher than ideal bodyweight.

Intensive Care Procedures

Tracheal intubation

For tracheal intubation, the same dose should be used as described above under surgical procedures.

Maintenance dosing

The use of an initial loading dose of 0.6 mg rocuronium bromide per kg body weight is recommended, followed by a continuous infusion as soon as twitch height recovers to 10% or upon reappearance of one to two twitches to train of four stimulation. Dosage should always be titrated to effect in the individual patient. The recommended initial infusion rate for the maintenance of a neuromuscular block of 80 to 90% (one to two twitches to TOF stimulation) in adult patients is 0.3 to 0.6 mg/kg/hour during the first hour of administration, which will need to be decreased during the following 6 to 12 hours, according to the individual response. Thereafter, individual dose requirements remain relatively constant.

A large between patient variability in hourly infusion rates has been found in controlled studies, with mean hourly infusion rates ranging from 0.2 to 0.5 mg/kg/hour depending on nature and extent of organ failure(s), concomitant medication and individual patient characteristics. To provide optimal individual patient control, monitoring of neuromuscular transmission is strongly recommended. Administration up to seven days has been investigated. There are no data to support dose recommendations for the facilitation of mechanical ventilation in paediatric and geriatric patients.

Patients with multiple organ failure require lower infusion rates. (See also section 4.4 Special warnings and precautions for use)

Prolonged use (> 48 hours) of non-depolarising muscle relaxants in the ICU should be avoided. (See also section 4.4 Special warnings and precautions for use)

Physical compatibilities

Compatibility studies with the following infusion fluids have been performed. In nominal concentrations of 0.5 mg/mL and 2.0 mg/mL rocuronium bromide injection has been shown to be compatible with 0.9% NaCl, 5% glucose, 5% glucose in saline, sterile water for injections, Compound Sodium Lactate and Haemacel.

To reduce microbiological hazard, use as soon as practicable after reconstitution/dilution. If storage is necessary, hold at 2 to 8°C for not more than 24 hours.

Administration should be begun immediately after mixing, and should be completed within 24 hours. Unused solutions should be discarded.

Prior to use, prepared infusions and syringes after withdrawal of the product from the vials should be stored at 2 to 8°C and used as soon as practicable after preparation. Any unused solution and product withdrawn into a syringe should be discarded after 24 hours.

If multiple use in one patient is intended, product withdrawn into a syringe should be used within 6 hours of the initial dose, and any remainder discarded.

The drugs for which incompatibilities have been demonstrated are listed below.

Physical incompatibilities.

Refer Section 6.2 Incompatibilities.

4.3 Contraindications

Known hypersensitivity to rocuronium or the bromide ion or to any of the excipients.

4.4 Special warnings and precautions for use

Risk of death due to medication errors

Administration of rocuronium results in paralysis, which may lead to respiratory arrest and death, a progression that may be more likely to occur in a patient for whom it is not intended. Confirm proper selection of intended product and avoid confusion with other injectable solutions that are present in critical care and other clinical settings. If another healthcare provider is administering the product, ensure that the intended dose is clearly labelled and communicated.

Particularly in the case of former anaphylactic reactions, rocuronium bromide should be administered only under the supervision of an experienced clinician.

Since rocuronium causes paralysis of the respiratory muscles, ventilatory support is mandatory for patients treated with this drug. Ventilation should be continued until adequate spontaneous respiration is restored. As with all neuromuscular blocking agents, it is important to anticipate intubation difficulties, particularly when used as part of a rapid sequence induction technique.

In case of intubation difficulties resulting in a clinical need for immediate reversal of a rocuronium induced neuromuscular block, the use of sugammadex should be considered.

As with other neuromuscular blocking agents, residual curarization has been reported for rocuronium bromide. Geriatric patients (65 years or older) may be at increased risk for residual neuromuscular block. Factors which could cause residual curarization after extubation in the post-operative phase (such as drug interactions or patient condition) should also be considered. If not already used as part of usual clinical practice, the use of a reversal agent should be considered, especially in those cases where residual curarization is more likely to occur.

Anaphylactic reactions can occur following administration of neuromuscular blocking agents. Precautions for treating such reactions should always be taken. Allergic cross-reactivity between muscle relaxants has been reported.

In general, following long term use of neuromuscular blocking agents in the ICU, prolonged paralysis and/or skeletal muscle weakness has been noted. In order to help preclude possible prolongation of neuromuscular block and/or overdose it is strongly recommended that neuromuscular transmission is monitored throughout the use of neuromuscular blocking agents. In addition, patients should receive adequate analgesia and sedation. Furthermore, neuromuscular blocking agents should be titrated to effect in individual patients by or under supervision of experienced clinicians who are familiar with their actions and with appropriate neuromuscular monitoring techniques.

Myopathy after long term administration of other non-depolarizing neuromuscular blocking agents in the ICU in combination with corticosteroid therapy has been reported regularly. Therefore the period of use of the neuromuscular blocking agent should be limited as much as possible in patients receiving both neuromuscular blocking agents and corticosteroids.

If suxamethonium is used for intubation, the administration of DBL Rocuronium Bromide Injection should be delayed until the patient has clinically recovered from the neuromuscular block induced by suxamethonium.

Doses of rocuronium bromide greater than 0.9 mg/kg may increase the heart rate; this effect could counteract the bradycardia produced by other anaesthetic agents or by vagal stimulation.

Prolonged use (> 48 hours) of non-depolarising muscle relaxants in the ICU should be avoided. (See section 4.2 Dose and method of administration)

Patients with multiple organ failure require lower infusion rates. (See section 4.2 Dose and method of administration)

The following conditions may influence the pharmacokinetics and/or pharmacodynamics of rocuronium. A peripheral nerve stimulator may be of use in monitoring the neuromuscular response in patients with such complications.

Infants (*one month to twelve months of age*): Mean onset time in infants and children at an intubation dose of 0.6 mg/kg is slightly shorter than in adults. The duration of relaxation and the time to recovery tend to be shorter in children compared to infants and adults.

Prolonged Circulation Time

Conditions associated with prolonged circulation time such as cardiovascular disease, old age and oedematous state resulting in an increased volume of distribution may contribute to a slower onset of action of rocuronium. The duration of action may also be prolonged due to a reduced plasma clearance.

Neuromuscular Disease

Like other neuromuscular blocking agents, rocuronium bromide should be used with extreme caution in patients with neuromuscular disease or after poliomyelitis since the response to neuromuscular blocking agents may be considerably altered in these cases. The magnitude and direction of this alteration may vary widely. In patients with myasthenia gravis or with the myasthenic (Eaton-Lambert) syndrome, small doses of rocuronium bromide may have profound effects and rocuronium bromide should be titrated to the response.

Hypothermia

In surgery under hypothermic conditions, the neuromuscular blocking effect of rocuronium is increased and the duration prolonged.

Obesity

Like other neuromuscular blocking agents, rocuronium may exhibit a prolonged duration of action and a prolonged spontaneous recovery in obese patients, when the administered doses are calculated on actual body weight.

Burns

Patients with burns are known to develop resistance to non-depolarising neuromuscular blocking agents. It is recommended that the dose is titrated to response.

Conditions which may increase the effects of DBL Rocuronium Bromide Injection

Hypokalaemia (e.g. after severe vomiting, diarrhoea and diuretic therapy), hypocalcaemia (after massive transfusion), hypermagnesaemia, hypoproteinaemia, dehydration, acidosis, hypercapnia and cachexia may all increase the effects of rocuronium. Severe electrolyte disturbances, altered blood pH and dehydration should therefore be corrected prior to surgery whenever possible.

Use in renal and hepatic impairment

Because rocuronium is excreted in urine and bile, it should be used with caution in patients with clinically significant hepatic and/or biliary diseases and/or renal failure. In these patient groups prolongation of action has been observed with doses of 0.6 mg/kg rocuronium bromide. It is recommended the infusion rate is titrated to effect.

Use in the elderly

No data available.

Paediatric use

Mean onset time in infants and children at an intubation dose of 0.6 mg/kg is slightly shorter than in adults. The duration of relaxation and the time to recovery tend to be shorter in children compared to infants and adults.

In one study the clinical duration of action was 43 minutes in infants when compared with 26 minutes in children aged 3 – 8 years. In a second study two of twenty subjects exhibited a prolonged duration of response and another two subjects appeared to be resistant to reversal of effects with neostigmine.

Effects on laboratory tests

No data available.

4.5 Interactions with other medicines and other forms of interactions

Coadministration of the following compounds has been shown to influence the magnitude and/or the duration of action of non-depolarising neuromuscular blocking agents.

Effect of other drugs on DBL Rocuronium Bromide Injection

Increased Effect

- Halogenated volatile anaesthetics potentiate the neuromuscular block of DBL Rocuronium Bromide Injection. The effect only becomes apparent with maintenance dosing (See section 4.2 Dose and method of administration). With the presence of these volatile agents reversal of the block with anticholinesterase inhibitors could also be inhibited.
- After intubation with suxamethonium (See section 4.2 Dose and method of administration)
- Long term concomitant use of corticosteroids and DBL Rocuronium Bromide Injection in the ICU may result in prolonged duration of neuromuscular block or myopathy (See section 4.4 Special warnings and precautions for use and section 4.8 Adverse effects)

Other Drugs

- Antibiotics: aminoglycoside, lincosamide and polypeptide antibiotics, acylamino-penicillin antibiotics
- Diuretics, quinidine and its isomer quinine, magnesium salts, calcium channel blocking agents, lithium salts, local anaesthetics (lignocaine I.V., bupivacaine epidural) and acute administration of phenytoin or β -blocking agents.

Recurarization has been reported after post-operative administration of: aminoglycoside, lincosamide, polypeptide and acylamino-penicillin antibiotics, quinidine, quinine and magnesium salts (See section 4.4 Special warnings and precautions for use).

Decreased Effect

- Prior chronic administration of corticosteroids, phenytoin or carbamazepine

Variable Effect

- Administration of other non-depolarising neuromuscular blocking agents in combination with DBL Rocuronium Bromide Injection may produce potentiation or attenuation of the neuromuscular block, depending on the order of administration and the neuromuscular blocking agent used.
- Suxamethonium given after the administration of a non-depolarising neuromuscular blocking agent may produce potentiation or attenuation of the neuromuscular blocking effect of the non-depolarising neuromuscular blocking agent.

Effect of DBL Rocuronium Bromide Injection on other drugs

DBL Rocuronium Bromide Injection combined with lignocaine may result in a quicker onset of lignocaine.

Paediatric patients

No formal interaction studies have been performed. The above mentioned interactions for adults and their special warnings and precautions for use (see section 4.4 Special warnings and precautions for use) should also be taken into account for paediatric patients.

4.6 Fertility, pregnancy and lactation

Effects on fertility

Fertility studies with rocuronium bromide have not been conducted.

Use in pregnancy – Pregnancy Category B2

Rocuronium bromide was not embryotoxic and/or teratogenic when administered to rats during pregnancy (day 6 to day 17) at IV neuromuscular blocking doses of 0.3 mg/kg. There are no adequate and well-controlled studies in pregnant women. DBL Rocuronium Bromide Injection should be used in pregnancy only if the potential benefits justify the potential risk to the foetus.

In patients receiving magnesium sulphate for toxemia the dose of rocuronium bromide should be reduced and carefully titrated to twitch response.

Australian categorisation definition of Category B2:

Drugs that have been taken by only a limited number of pregnant women and women of childbearing age, without an increase in the frequency of malformation or other direct or indirect harmful effects on the human foetus having been observed. Studies in animals[1] are inadequate or may be lacking, but available data show no evidence of an increased occurrence of foetal damage.

Use in lactation

Insignificant levels of rocuronium were found in the milk of lactating rats, however, there are no data on the use of rocuronium bromide in lactating women. Rocuronium bromide should only be given to lactating women when the attending physician decides that the benefits outweigh the risks.

4.7 Effects on ability to drive and use machines

Since DBL Rocuronium Bromide Injection is used as an adjunct to general anaesthesia, the usual precautionary measures after a general anaesthetic should be taken for ambulatory patients.

4.8 Adverse effects (undesirable effects)

The most commonly occurring adverse drug reactions include injection site pain/reaction, changes in vital signs and prolonged neuromuscular block. The most frequently reported serious adverse drug reactions during post-marketing surveillance is “anaphylactic and anaphylactoid reactions” and associated symptoms. See also the explanation notes below the table.

MedDRA SOC	Preferred Term ^a		
	Uncommon / Rare ^b (<1/100, >1/10,000)	Very Rare (<1/10,000)	Not Known
Immune System Disorders		Hypersensitivity Anaphylactic reaction Anaphylactoid reaction Anaphylactic shock Anaphylactoid shock	
Nervous System Disorders		Flaccid paralysis	
Cardiac Disorders	Tachycardia		Kounis syndrome
Vascular Disorders	Hypotension	Circulatory collapse and shock Flushing	
Respiratory, Thoracic and Mediastinal Disorders		Bronchospasm	
Skin and Subcutaneous Tissue Disorders		Angioneurotic oedema Urticaria Rash Erythematous rash	
Musculoskeletal and Connective Tissue Disorders		Muscular weakness ^c	

	Preferred Term^a		
MedDRA SOC	Uncommon / Rare^b (<1/100, >1/10,000)	Very Rare (<1/10,000)	Not Known
		Steroid myopathy ^c	
General Disorders and Administrative Site Conditions	Drug Ineffective Drug Effect / Therapeutic Response decreased Drug Effect / Therapeutic Response increased Injection Site Pain Injection Site Reaction	Face oedema Malignant hyperthermia	
Injury, Poisoning and Procedural Complications	Prolonged Neuromuscular Block Delayed recovery from the Anaesthesia	Airway complication of anaesthesia	

a = Frequencies are estimates derived from post-marketing surveillance reports and data from the general literature

b = Post-marketing surveillance data cannot give precise incidence figures. For that reason, the reporting frequency was divided over two rather than five categories.

c = After long term use in the ICU

Anaphylaxis

Although very rare, severe anaphylactic reactions to neuromuscular blocking agents, including rocuronium bromide injection, have been reported. Anaphylactic/anaphylactoid reactions are: bronchospasm, cardiovascular changes (e.g. hypotension, tachycardia, circulatory collapse – shock), and cutaneous changes (e.g. angioedema, urticaria). These reactions have, in some cases, been fatal.

Since neuromuscular blocking agents are known to be capable of inducing histamine release both locally and systemically, the possible occurrence of itching or erythematous reactions at the site of injection and/or generalized histaminoid (anaphylactoid) reactions (see also under anaphylactic reactions above) should always be considered when administering these drugs.

In clinical studies only a slight increase in mean plasma histamine levels has been observed following rapid bolus administration 0.3 – 0.9 mg/kg rocuronium bromide.

Local injection site reactions

During rapid sequence induction of anaesthesia, pain on injection has been reported, especially when the patient has not yet completely lost consciousness and particularly when propofol is used as the induction agent. In clinical studies, pain on injection has been noted in 16% of the patients who underwent rapid sequence induction of anaesthesia with propofol and in less than 5% of the patients who underwent rapid sequence induction of anaesthesia with fentanyl and thiopental.

Prolonged neuromuscular block

The most frequent adverse reaction to non-depolarising blocking agents as a class consists of an extension of the drug's pharmacological action beyond the time period needed. This may vary from skeletal muscle weakness to profound and prolonged skeletal muscle paralysis resulting in respiratory insufficiency or apnoea.

Intensive Care Unit myopathy

Myopathy has been reported after the use of various neuromuscular blocking agents in the ICU in combination with corticosteroids (See section 4.4 Special warnings and precautions for use).

Rapid Sequence Induction Clinical Trial Data

The percentage of patients with at least one adverse event, with causality related to the study drug, is tabulated below for the all-patients-treated groups of both pivotal studies. It includes all adverse events reported with an incidence of 1% or greater. A dash represents an incidence of less than 1%.

Body System	Study Group		
	0.6 mg/kg rocuronium bromide (n = 126) %	1.0 mg/kg rocuronium bromide (n = 281) %	1.0 mg/kg suxamethonium (n = 287) %
Skin and Appendages Disorders			
Rash	3	4	3
Urticaria	-	1	-
Nervous & Musculo-Skeletal System Disorders			
Muscle Weakness	-	1	-
Muscle Contractions Involuntary	-	-	23
Cardiovascular Disorders			
Tachycardia	-	1	-
Respiratory System Disorders			
Bronchospasm	-	2	1
Application Site Disorders			
Injection Site Pain	7	9	1

Intensive Care Unit Clinical Trial Data

The percentage of patients with at least one adverse event, with causality related to the study drug, are tabulated below for the all-patients-treated groups of both pivotal studies. It includes all adverse events reported with an incidence of 1% or greater.

Body System	All-patients-treated groups (n=95)
Cardiovascular Disorders, General	
ECG abnormal	1

Hypotension	2
Heart Rate and Rhythm Disorders	
Cardiac Arrest	1
Tachycardia	1
Musculo-Skeletal System Disorders	
Myopathy	1
Resistance Mechanism Disorders	
Sepsis	1
Respiratory System Disorders	
Respiratory Insufficiency	1
Vascular (extracardiac) Disorders	
Thrombophlebitis Deep	1

Paediatric patients

A meta-analysis of 11 clinical studies in paediatric patients (n=704) with rocuronium bromide (up to 1 mg/kg) showed that tachycardia was identified as an adverse drug reaction with a frequency of 1.4%.

Reporting suspected adverse effects

Reporting suspected adverse reactions after registration of the medicinal product is important. It allows continued monitoring of the benefit-risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions at www.tga.gov.au/reporting-problems.

4.9 Overdose

Symptoms

The symptoms of overdosage with a non-depolarising muscle relaxant are those of prolonged paralysis, apnoea, low tidal volume, respiratory depression and/or persistent muscle weakness. In animal studies, severe depression of cardiovascular function ultimately leading to cardiac collapse did not occur until a cumulative dose of 750 times the ED₉₀ (135 mg/kg rocuronium bromide) was administered.

Treatment

In the event of overdosage and prolonged neuromuscular block, the patient should continue to receive ventilatory support and sedation. In this situation there are two options for the reversal of neuromuscular block: (1) Sugammadex can be used for reversal of intense (profound) and deep block. The dose of sugammadex to be administered depends of the level of neuromuscular block. (2) An acetylcholinesterase inhibitor (e.g. neostigmine, edrophonium, pyridostigmine), with appropriate vagolytic (e.g. atropine) can be used at reappearance of T₂ or at the first signs of clinical recovery and should be administered in adequate doses. If administration of an

acetylcholinesterase inhibiting agent fails to reverse the effects of rocuronium, ventilation must be continued until spontaneous breathing is restored.

Use of a reversal agent should not begin until definite signs of spontaneous recovery are present. Overdosage of an acetylcholinesterase inhibitor can be dangerous.

For information on the management of overdose, contact the Poisons Information Centre on 13 11 26 (Australia).

5. PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Mechanism of action

Rocuronium is a fast onset (relative to vecuronium), intermediate acting non-depolarising neuromuscular blocking agent. It acts by competing with the natural transmitter acetylcholine and blocking the cholinceptors located at the motor endplate of the striated muscle. This is unlike suxamethonium which causes depolarisation and renders the endplate, after initial contraction, unresponsive to stimuli, thus producing paralysis of the striated muscle. The action of rocuronium is antagonised by acetylcholinesterase inhibitors such as neostigmine, edrophonium and pyridostigmine. The neuromuscular block can also be reversed by sugammadex, a Selective Relaxant Binding Agent. Rocuronium does not produce clinically significant autonomic and cardiovascular effects within the recommended dose range and is not expected to modulate cardiovascular effects of anaesthetics or other drugs used during surgery.

The ED₉₀ (dose required to produce 90% depression of the twitch response of the thumb to stimulation of the ulnar nerve) during balanced anaesthesia is approximately 0.3 mg/kg rocuronium bromide. The ED₉₅ in infants is lower than in adults and children (0.25, 0.35 and 0.40 mg/kg, respectively).

The mean pharmacodynamic parameter values for rocuronium over a range of doses are presented in Tables 1 and 2.

Table 1: Intubating conditions in Adult Patients (18-64 years)

Rocuronium bromide Dose (mg/kg)	Percent of Patients with Excellent or Good Intubating Conditions at:	
	60 seconds	90 seconds
0.30 (n = 14)	86%	86%
0.45 (n = 14)	86%	100%
0.60 (n = 121)	99%	96%

Excellent intubating conditions = jaw relaxed, vocal cords apart and immobile, no diaphragmatic movement.

Good intubating conditions = jaw relaxed, vocal cords apart and immobile, some diaphragmatic movement.

Table 2: Pharmacodynamic Parameter Values for the Total Dose of Rocuronium Bromide in Adults and Geriatric Patients, under Intravenous Anaesthesia and in Children under Halothane Anaesthesia (mean values)

Total Dose of Rocuronium Bromide (mg/kg)	Onset Time (minutes)	Clinical Duration* (minutes)
Adults (18 – 64 years)		
0.30 (n = 14)	4.8	11.0
0.45 (n = 14)	3.4	21.4
0.60 (n = 69)	2.1	35.8
0.90 (n = 30)	1.8	55.9
1.20 (n = 15)	1.8	84.6
Geriatrics (65 – 78 years)		
0.30 (n = 5)	3.4	19.7
0.60 (n = 5)	4.5	42.4
Paediatrics (3 months – 1 year)		
0.80 (n = 9)	0.6	43.4
Paediatrics (1-14 years)		
0.30 (n = 108)	-	15.7
0.80 (n = 16)	0.5	32.3

* = Clinical duration = duration until spontaneous recovery to 25% of control twitch height

The clinical duration (the duration until spontaneous recovery to 25% of control twitch height) with 0.6 mg/kg rocuronium bromide is 30 to 40 minutes. The total duration (time until spontaneous recovery to 90% of control twitch height) is 50 minutes. The mean time of spontaneous recovery of twitch response from 25 to 75% (recovery index) after a bolus dose of 0.6 mg/kg rocuronium bromide is 14 minutes.

With lower doses of 0.3 to 0.45 mg/kg rocuronium bromide (1 to 1.5 times ED₉₀), onset of action is slower and duration of action is shorter. With high doses of 2 mg/kg, clinical duration is 110 minutes.

Intubation during routine anaesthesia

Within 60 seconds following intravenous administration of a dose of 0.6 mg/kg rocuronium bromide (two times ED₉₀ under intravenous anaesthesia), adequate intubation conditions can be achieved in nearly all patients of which in 80% intubation conditions are rated excellent. General muscle paralysis for any type of procedure is established within two minutes. After administration of 0.45 mg/kg rocuronium bromide, acceptable conditions are present after 90 seconds.

Rapid Sequence Induction

During rapid sequence induction of anaesthesia under propofol or fentanyl/ thiopental anaesthesia, adequate intubation conditions are achieved within 60 seconds in 93% and 96% of the patients, respectively, following a dose of 1.0 mg/kg rocuronium bromide. The rate of excellent intubations after a 1.0 mg/kg rocuronium dose was achieved in 66% and 65% of the patients, respectively. The clinical duration with this dose approaches one hour, at which time the neuromuscular block can be safely reversed. Following a dose of 0.6 mg/kg rocuronium bromide, adequate intubation conditions are achieved within 60 seconds in 81% and 75% of the patients during a rapid sequence induction technique with propofol and fentanyl/thiopental, respectively.

Special populations

Mean onset time in infants and children at an intubation dose of 0.6 mg/kg is slightly shorter than in adults. The duration of relaxation and the time to recovery tend to be shorter in children compared to infants and adults.

The duration of action of maintenance doses of 0.15 mg/kg rocuronium bromide might be somewhat longer under enflurane and isoflurane anaesthesia and in patients with hepatic disease (approximately 20 minutes) than in patients without impairment of excretory organ functions under intravenous anaesthesia (approximately 13 minutes). No accumulation of effect (progressive increase in duration of action) with repetitive dosing at the recommended level has been observed.

Intensive Care Unit

Following continuous infusion in the Intensive Care Unit (ICU), the time to recovery of the train of four (TOF) ratio to 0.7 depends on the level of block at the end of the infusion. After a continuous infusion for 20 hours or more the median (range) time between return of T₂ to train of four stimulation and recovery of the train of four ratio to 0.7 approximates 1.5 (one to five) hours in patients without multiple organ failure and four (1 to 25) hours in patients with multiple organ failure.

Cardiovascular surgery

In patients scheduled for cardiovascular surgery the most common cardiovascular changes during the onset of maximum block following 0.6 to 0.9 mg/kg rocuronium bromide are a slight and clinically insignificant increase in heart rate up to 9% and an increase in mean arterial blood pressure up to 16% from the control values.

Reversal of muscle relaxation.

The action of rocuronium can be antagonized either by sugammadex or by acetylcholinesterase inhibitors (neostigmine, pyridostigmine or edrophonium). Sugammadex can be given for routine reversal (at 1-2 post-tetanic counts to reappearance of T₂) or immediate reversal (3 minutes after rocuronium bromide administration). Acetylcholinesterase inhibitors can be administered in appropriate dosage, as reappearance of T₂ or at the first signs of clinical recovery.

Clinical trials

The use of rocuronium bromide during rapid sequence induction of anaesthesia was studied in two pivotal studies, including a total of 681 adults and elderly patients, one using 3 to 5 mg/kg

thiopentone (plus fentanyl) as the induction agent, and the other using 2.5 mg/kg propofol. The studies included three study groups: 0.6 mg/kg rocuronium, 1.0 mg/kg rocuronium, and 1.0 mg/kg suxamethonium. The patients were intubated within 60 seconds after the end of muscle relaxant administration. In the first part of both studies, intubation conditions after 0.6 mg/kg and 1.0 mg/kg rocuronium bromide were compared. In the second part of both studies, the optimal rocuronium dose was compared with 1.0 mg/kg suxamethonium. The optimal rocuronium dose (i.e. 1.0 mg/kg in both studies) and 1.0 mg/kg suxamethonium were considered to be clinically equivalent if a difference of less than 10% in the number of clinically acceptable intubating conditions was demonstrated. Based on this assumption a 13% rate of clinically unacceptable intubating conditions would have been acceptable. In the first part of both studies, it was demonstrated that the frequency of excellent intubating conditions was higher after a 1.0 mg/kg rocuronium dose than after the 0.6 mg/kg dose (65% versus 28% in the thiopentone study and 66% versus 40% in the propofol study). The percentage of clinically acceptable intubating conditions is comparable for 1.0 mg/kg rocuronium compared to 1.0 mg/kg suxamethonium although rocuronium resulted less frequently in excellent intubating conditions (65% versus 80% in the thiopentone study and 66% versus 74% in the propofol study, although statistical significance was not reached in the latter study). In the thiopentone study, intubation could not be performed in 2% of the patients in the 0.6 mg/kg rocuronium group and in 1% of the patients in the 1.0 mg/kg rocuronium group 60 seconds after administration of the muscle relaxant. Intubation could be performed in all patients receiving 1.0 mg/kg suxamethonium. In the propofol study, intubation could not be performed in 1% of the patients in the 1.0 mg/kg rocuronium group and in 1% of the patients in the 1.0 mg/kg suxamethonium group but in all patients in the 0.6 mg/kg rocuronium group. These studies do not provide information on the relative time to onset of suxamethonium versus rocuronium bromide as the protocols specified assessment of intubation conditions at 60 seconds.

The use of rocuronium bromide in the Intensive Care Unit to facilitate mechanical ventilation was studied in two pivotal studies, including a total of 95 adult patients; 35 of the 95 patients (37%) had received rocuronium bromide for at least two days, and eleven (12%) for four days. Both patients with and without multiple organ failure were included. In both studies, rocuronium bromide administration started with a large loading bolus of 0.6 mg/kg and upon reappearance of one or two responses to TOF stimulation, a rocuronium bromide infusion was started for as long as required up to a maximum of seven days.

There are no data to support ICU use in infants, children, elderly (> 70 years old), those with burns and pre-existing myopathy.

5.2 Pharmacokinetic properties

Pharmacokinetics

After intravenous administration of a single bolus dose of rocuronium bromide the plasma concentration time course runs in three exponential phases. In normal adults, the mean (95%CI) elimination half-life is 73 (66 - 80) minutes, the (apparent) volume of distribution at steady state conditions is 203 (193 – 214) mL/kg and plasma clearance is 3.7 (3.5 – 3.9) mL/kg/min.

Geriatric patients and patients with hepatic and/or biliary tract disease and/or renal failure

In controlled studies in geriatric patients and in patients with renal dysfunction, the plasma clearance was reduced. In most studies, however, this reduction was not statistically significant. In patients with hepatic disease, the mean elimination half-life is prolonged by 30 minutes and the mean plasma clearance is reduced by 1.0 mL/kg/min. (See also section 4.2 Dose and method of administration).

Paediatric patients

In infants (3 months to 1 year), the apparent volume of distribution at steady state conditions is increased compared to adults and children (1 – 8 years). In older children (3 – 8 years), a trend is seen toward higher clearance and shorter elimination half-life compared to adults, younger children and infants. The mean (\pm SD) elimination half-life in older children (3 – 8 years), adults, younger children (1 – 3 years) and infants (3 – 12 months) is respectively 48 (\pm 18), 73 (\pm 32), 65 (\pm 39) and 79 (\pm 30) minutes.

Intensive Care Unit

When administered as a continuous infusion to facilitate mechanical ventilation for 20 hours or more, the mean elimination half-life and the mean (apparent) volume of distribution at steady state are increased. A large between patient variability is found in controlled clinical studies, related to nature and extent of (multiple) organ failure and individual patient characteristics. In patients with multiple organ failure a mean (\pm SD) elimination half-life of 21.5 (\pm 3.3) hours, a (apparent) volume of distribution at steady state of 1500 (\pm 800) mL/kg and a plasma clearance of 2.1 (\pm 0.8) mL/kg/min were found.

Rocuronium is excreted in urine and bile. Excretion in urine approaches 40% within 12 – 24 hours. After injection of a radiolabeled dose of rocuronium bromide, excretion of the radiolabel is on average 47% in urine and 43% in faeces after 9 days. Approximately 50% is recovered as the parent compound.

There is no proper animal model to mimic the usually extremely complex clinical situation of the ICU patient. Therefore the safety of DBL Rocuronium Bromide Injection when used to facilitate mechanical ventilation in the Intensive Care Unit is mainly based on the results obtained in clinical studies.

5.3 Preclinical safety data

Genotoxicity

Rocuronium bromide showed no genotoxic potential in standard assays of gene mutation and chromosomal damage.

Carcinogenicity

Carcinogenicity studies with rocuronium bromide have not been conducted.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

sodium acetate

sodium chloride

acetic acid and/or sodium hydroxide q.s. to adjust pH to within the range of 3.8 -4.2

6.2 Incompatibilities

Physical incompatibility has been documented when rocuronium bromide injection is added to solutions containing amoxicillin, amphotericin, azathioprine, cephazolin, cloxacillin, dexamethasone, diazepam, erythromycin, famotidine, frusemide, hydrocortisone sodium succinate, insulin, intralipid, methylprednisolone, prednisolone sodium succinate, thiopentone sodium, trimethoprim and vancomycin hydrochloride.

Rocuronium bromide injection must not be mixed with other solutions or drugs except those mentioned in section 4.2 Dose and method of administration: Physical compatibilities).

If rocuronium bromide injection is administered via the same infusion line that is also used for other drugs, it is important that this infusion line is adequately flushed (e.g. with 0.9% NaCl) between administration of rocuronium bromide injection and drugs for which incompatibility with rocuronium bromide injection has been demonstrated or for which compatibility with rocuronium bromide injection has not been established.

6.3 Shelf life

In Australia, information on the shelf life can be found on the public summary of the Australian Register of Therapeutic Goods (ARTG). The expiry date can be found on the packaging.

6.4 Special precautions for storage

DBL Rocuronium Bromide Injection should be stored at 2°C - 8°C. DBL Rocuronium Bromide Injection is intended to be used for one dose and in one patient only. Unused solutions should be discarded. DBL Rocuronium Bromide Injection should not be returned to 2°C - 8°C storage after it has been kept outside the refrigerator at 8°C - 30°C (i.e. normal use in the anaesthetic room or operating theatre). The date of removal should be noted on the vial and the product discarded if not used in 12 weeks.

6.5 Nature and contents of container

DBL Rocuronium Bromide Injection is available as 10 x 5 mL vials, each vial containing 50 mg of Rocuronium bromide.

6.6 Special precautions for disposal

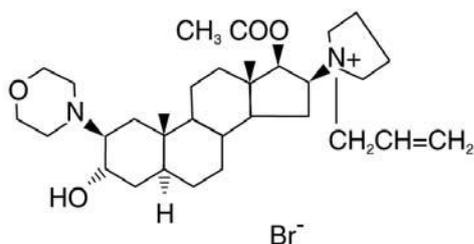
In Australia, any unused medicine or waste material should be disposed of in accordance with local requirements.

6.7 Physicochemical properties

Rocuronium bromide is a quaternary aminosteroid and an analogue of vecuronium bromide. It is an off-white to pale-yellow or slightly pink amorphous powder and is chemically designated as 1-[17 β -(acetyloxy)-3 α -hydroxy-2 β -(4-morpholinyl)-5 α -androstan-16 β -yl]-1-(2propenyl)pyrrolidinium bromide. Its molecular and structural formula is shown below.

Rocuronium bromide is readily soluble in water (> 200 mg/mL) and a 1% w/v solution in water has a pH of 8.9 – 9.5. In aqueous solution rocuronium bromide is more stable at acidic pH.

Chemical structure



Molecular Formula: C₃₂H₅₃BrN₂O₄

Molecular weight: 609.7

CAS number

119302-91-9

7. MEDICINE SCHEDULE (POISONS STANDARD)

S4 (Prescription Only Medicine)

8. SPONSOR

Pfizer Australia Pty Ltd
Level 17, 151 Clarence Street
Sydney NSW 2000
Toll Free Number: 1800 675 229
www.pfizer.com.au

9. DATE OF FIRST APPROVAL

13 August 2010

10. DATE OF REVISION

04 May 2022

Summary Table of Changes

Section changed	Summary of new information
4.2	Addition of safety warning in relation to risk of medication errors; Physical incompatibilities moved to Section 6.2
4.4	Addition of warning of geriatric patients and risk of residual neuromuscular block, and safety warning in relation to risk of death due to medication errors.
4.5	Addition of reference relating to paediatric patients.
4.8	Addition of side effects ‘malignant hyperthermia’ and ‘Kounis syndrome’; Addition of ‘tachycardia’ in paediatric patients.
5.2	Addition of sub-heading
6.2	Text moved from section 4.2 to Section 6.2 re incompatibilities

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