ROCURONIUM
Newborn use only

2021

Alert	High-risk medicine: High risk of causing significant patient harm when used in error. This drug should be administered in the presence of personnel trained in advanced airway management. Suggest regular cessation of infusion for a few to several hours, possibly every 24 hours (commonly referred to as 'drug holiday'[1]) to assess the need for continued paralysis and adequacy of sedation or analgesia. Line should be adequately flushed to avoid unintended paralysis during later use of the line.
Indication	1. Skeletal muscle relaxation or paralysis in mechanically ventilated infants 2. For elective endotracheal intubation
Action	Non-depolarising muscle relaxant that competitively antagonises nicotinic acetylcholine receptors at the neuromuscular junction. Also competitively antagonises autonomic nicotinic acetylcholine receptors and may result in increased heart rate and reduced blood pressure.
Drug type	Non-depolarising neuromuscular blocking agent
Trade name	DBL Rocuronium Bromide, Rocuronium Sandoz, Rocuronium Mylan, Esmeron
Presentation	50 mg/5 mL vial 100 mg/10 mL vial
Dose	**Intubation** IV bolus: 600 microgram/kg (400-1000 microgram/kg) **Muscle relaxation** ***Intermittent IV bolus***: 600 microgram/kg (400 – 1000 microgram) every 30 to 60 minutes as needed. ***Continuous infusion*** OPTIONAL LOADING DOSE: IV loading dose of 0.6 mg/kg Continuous infusion of 600 microgram/kg/hour (400–1000 microgram/kg/hour). Titrate until desired neuromuscular blockade is achieved.
Dose adjustment	No information.
Maximum dose	2 mg/kg/dose
Total cumulative dose	
Route	IV bolus, IV infusion
Preparation	**IV bolus injection**: Draw up 1 ml (10 mg of rocuronium) and add 4 mL of sodium chloride 0.9% to make a final volume of 5 mL with a final concentration of 2000 microgram/mL **Continuous IV infusion**: **Infusion strength** / **Prescribed amount** 1 mL/hour = 600 microgram/kg/hour / 30 mg/kg rocuronium and make up to 50 mL Draw up 3 mL/kg (30 mg/kg of rocuronium) and add sodium chloride 0.9% or glucose 5% to make a final volume of 50 mL with a concentration of 0.6 mg/kg/mL. Infusing a rate of 1 mL/hour = 600 microgram/kg/hour. **IV bolus** from this solution: 0.5 - 1 mL = 300-600 microgram/kg.
Administration	IV bolus over 5–10 seconds IV continuous infusion Line should be adequately flushed upon cessation of treatment to avoid unintended paralysis during later use of the same line.
Monitoring	Continuous cardiorespiratory and pulse oximetry monitoring. Close monitoring of neuromuscular function, sedation and blood pressure (invasive or non-invasive) is essential. Electrolytes and renal function.
Contraindications	Hypersensitivity to rocuronium or any component of the formulation. Cross-sensitivity with other neuromuscular-blocking agents may occur; use with extreme caution in patients with previous anaphylactic reactions.
Precautions	**Factors which can increase duration of neuromuscular blockade:** Acidosis, hypothermia, neuromuscular disease, hepatic disease, hypokalaemia, hypermagnesaemia, renal failure and younger age. **Factors which can decrease duration of neuromuscular blockade:**

	Alkalosis and hyperkalaemia Use cautiously in neonates with hepatic or renal impairment and in neonates with fluid and electrolyte imbalance. In the first week after birth, use cautiously in neonates whose mothers received magnesium sulfate infusion for pre-eclampsia or fetal neuroprotection. Assess regularly (at least every 24 hours) the need for ongoing use of muscle relaxant and neuromuscular function/blockade. Consider "drug holiday" in case of prolonged usage of >24 hours. Drug Holiday: A drug holiday refers to cessation of the NMBA for a period of time (at least until neuromuscular function begins to return) on a daily basis. At this point, clinicians should reassess need for ongoing treatment and restart the NMBA only when clinically necessary.[1, 2]
Drug interactions	Aminoglycosides and general anaesthetics can increase (potentiate) duration of neuromuscular blockade. Corticosteroids: In addition to prolonging recovery from neuromuscular blockade, concomitant use with corticosteroids has been associated with development of acute quadriplegic myopathy syndrome (AQMS). Current adult guidelines recommend neuromuscular blockers be discontinued as soon as possible in patients receiving corticosteroids or interrupted daily until necessary to restart them based on clinical condition.[3] Adrenaline (epinephrine) can reduce (antagonise) duration of neuromuscular blockade.
Adverse reactions	Hypoxaemia/hypercarbia may occur because of inadequate ventilation and deterioration in pulmonary mechanics Hypotension and bradycardia, particularly when used in combination with opioids Prolonged paralysis after long-term use Rare—anaphylactic reaction.
Compatibility	**Fluids**: Glucose 5%, sodium chloride 0.9%, water for injection, Hartmann's. **Y site** Milrinone, dexmedetomidine.
Incompatibility	**Fluids**: Lipid emulsion **Y site**: Amoxicillin, amphotericin B (amphotericin), azathioprine, cefazolin, cloxacillin, dexamethasone, diazepam, erythromycin, famotidine, furosemide, hydrocortisone sodium succinate, insulin, ketorolac, lorazepam, methylprednisolone, micafungin, prednisolone, piperacillin-tazobactam, potassium phosphates, quinine, thiopentone sodium, trimethoprim and vancomycin.[4, 5, 6]
Stability	Diluted solution is stable for up to 24 hours at 2–8°C
Storage	Refrigeration at 2–8°C. Stable for 12 weeks below 30°C (note the date of removal from fridge and do not return to the fridge).
Excipients	
Special comments	Muscle relaxation is reversed by neostigmine (60 microgram/kg) and atropine (20 microgram/kg). Sugammadex is also effective for rocuronium reversal in older patients but has not been systematically studied in neonates or infants. Sensation remains intact; sedation should be used in all patients and analgesia should be used for painful procedures. Provide eye protection and instil lubricating eye drops every 2 hours. Rocuronium produces significantly less tachycardia and hypotension when compared with pancuronium although more commonly than with vecuronium. The neuromuscular blockade of rocuronium is more rapid in onset than that of pancuronium and vecuronium. The duration of action is dose dependent and similar to vecuronium. Its action is prolonged in neonates compared to children and adults and therefore is similar to long-acting NMBAs in this population.[7]
Evidence	**Efficacy** <u>Muscle relaxation</u> The potency of rocuronium is significantly less (approximately one sixth) than that of pancuronium or vecuronium.[7, 8, 9] Rocuronium, although known to be shorter acting than pancuronium in older patients, tends to have a duration of action similar to that of a long-acting neuromuscular blocking agent in neonates. This may be

because infants require lower plasma drug concentrations for 50% depression of neuromuscular function and because their volume of distribution is larger than children or adults.[10]
In newborn and small infants up to 3 or 4 months, a dose of 0.45 mg/kg rocuronium bromide is sufficient for good neuromuscular blockade and satisfactory recovery times[7].

The majority of research regarding use of rocuronium in neonates and infants is in the setting of general anaesthesia. Therefore, given the known ability for anaesthetic agents to potentiate the effects of neuromuscular blocking agents, information on the pharmacodynamics of rocuronium in the NICU setting is limited.[7] In the anaesthetic setting, rocuronium is reported to rapidly induce paralysis and good intubating conditions, usually within 1 minute (faster than other non- depolarising agents).[11, 12] Time to recovery has not been consistently measured and, therefore, adult data are unlikely to be comparable. However, in neonatal patients it is dose dependent and up to 100 min.[7, 13]

Intubation
A randomised, controlled trial of rocuronium 0.5 mg/kg for elective intubation of neonates with fentanyl and atropine (control group fentanyl and atropine without muscle relaxation) showed 80% effectiveness in complete relaxation with the remaining 20% of infants having only minimal muscle activity. Onset of paralysis was between 4 and 178 seconds after administration and duration of action between 1 and 60 minutes.[14]
There are limited data on the use of rocuronium infusion in newborn infants. In a study of 20 patients (age 2 months to 16 years), rocuronium infusion provided satisfactory neuromuscular blockade.[1]

Safety
Rocuronium is excreted in both urine and bile; however, unlike vecuronium, it is not reported to have active metabolites which may prolong the duration of action. In adult patients, prolonged duration of action has been observed in the presence of hepatic or renal impairment. A study comparing children with renal failure (most on dialysis) to healthy children undergoing elective procedures compared the onset and duration of action of rocuronium during anaesthesia and found a longer time to onset of action but not prolongation of action in the group with renal failure. A low dose (0.3 mg/kg) was used in this study which may have influenced the results.[15]

Significant adverse events have not been reported in neonates with the exception of prolonged duration of action. Sugammadex has been reported to reverse the presumed central nervous effects of rocuronium in a neonate.[17] In older patients, immediate hypersensitivity reactions, prolonged duration of action and injection site reactions are the commonest adverse effects.[4] Transient tachycardia has been reported with higher doses.[16]

Pharmacokinetics
Clearance of rocuronium is via both urine and bile with approximately half via each route. Rocuronium has no active metabolites and approximately 50% of the drug is recovered unchanged.[4]

Onset of action is dose dependent and 15 seconds to 2 minutes; duration of action is 30–60 minutes (prolonged with higher doses and in preterm infants).

Practice points

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