neostigmine (nee-oh-stig-meen)
Bloxiverz, Prostigmin

Classification
Therapeutic: antimuscarinics
Pharmacologic: cholinergics

Pregnancy Category C

Indications

Action
Inhibits the breakdown of acetylcholine so that it accumulates and has a prolonged effect. Effects include miosis, increased intestinal and skeletal muscle tone, bronchial and uroteral constriction, bradycardia, increased salivation, lacrimation, and sweating. Therapeutic Effects: Improved muscular function in patients with myasthenia gravis, improved bladder-emptying in patients with urinary retention, or reversal of nondepolarizing neuromuscular blockers.

Pharmacokinetics
Absorption: Poorly absorbed following oral administration, necessitating large oral doses compared with parenteral doses; IV administration results in complete bioavailability.
Distribution: Probably does not cross the placenta or enter breast milk.
Metabolism and Excretion: Metabolized by plasma cholinesterases and the liver.
Half-life: PO 40–60 min; IM—50–90 min; IV—24–113 min.

TIME/ACTION PROFILE (cholinergic effects, increased muscle tone)

<table>
<thead>
<tr>
<th>Route</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO</td>
<td>45–75 min</td>
<td>unknown</td>
<td>2–4 hr</td>
</tr>
<tr>
<td>IM</td>
<td>10–30 min</td>
<td>20–30 min</td>
<td>2–4 hr</td>
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Contraindications/Precautions
Contraindicated in:
- Hypersensitivity; Mechanical obstruction of the GI or GU tract; Lactation:

Use Cautiously in:
- History of asthma; Ulcer disease; Cardiovascular disease; Seizure disorder; Hyperthyroidism;
- OB: May cause uterine irritability after IV administration near term; newborns may display muscle weakness.

Adverse Reactions/Side Effects
CNS: SEIZURES, dizziness, weakness.
EENT: lacrimation, miosis.
Resp: bronchospasm, excess secretions.
CV: bradycardia, hypotension.
GI: abdominal cramps, diarrhea, excess salivation, nausea, vomiting.
Derm: sweating, rash.

Interactions
Drug-Drug: Action may be antagonized by drugs possessing anticholinergic properties, including antihistamines, antidepressants, atropine, haloperidol, phenothiazines, quinidine, and disopyramide. Prolongs action of depolarizing muscle-relaxing agents (succinylcholine, decamethonium).

Route/Dosage

Myasthenia Gravis

PO (Adults): 15 mg q 3–4 hr initially; q at daily intervals until optimal response is achieved. Usual maintenance dose is 150 mg/day (up to 375 mg/day may be needed).

PO (Children): 2 mg/kg/day (10 mg/m2) in 6–8 divided doses.

Subcut, IM, Subcut (Adults): 0.5 mg.

Subcut, IM, Subcut (Children): 10–40 mcg/kg q 2–3 hr; may give with 10 mcg/kg atropine.

Bladder Atony, Abdominal Distention: Prevention

IM, Subcut (Adults): 250 mcg q 4–6 hr for 2–3 days.

Bladder Atony, Abdominal Distention: Treatment

IM, Subcut (Adults): 500 mcg as needed; may repeat q 3 hr for 5 doses after bladder has been emptied for bladder atony.

Reversal of Nondepolarizing Neuromuscular Blockers

IV (Adults and Children): 0.015 mg/kg for neuromuscular blockers with short half-life (e.g. vecuronium), 0.07 mg/kg for neuromuscular blockers with longer half-life

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**NURSING IMPLICATIONS**

**Assessment**
- Assess pulse, respiratory rate, and BP prior to administration. Report significant changes in heart rate.
- **Myasthenia Gravis**: Assess neuromuscular status, including vital capacity, ptosis, dyspnea, chewing, swallowing, hand grasp, and gait, prior to administering and at peak effect. Patients with myasthenia gravis may be advised to keep a daily record of their condition and the effects of this medication.
- Assess patient for overdose and underdose or resistance. Both have similar symptoms (muscle weakness, droop, dysphagia), but symptoms of overdose usually occur within 1 hr of administration, whereas underdose symptoms occur 3 or more hr after administration. Overdose (cholinergic crisis) symptoms may also include increased respiratory secretions and saliva, bradycardia, nausea, vomiting, cramping, diarrhea, and diaphoresis. A Tensilon test (edrophonium chloride) may be used to distinguish between overdose and underdose.
- **Postoperative Ileus**: Monitor abdominal status (assess for distention, auscultate bowel sounds). A rectal tube may be inserted to facilitate expulsion of flatus.
- **Postoperative Urinary Retention**: Assess for bladder distention. Monitor intake and output. If patient is unable to void within 1 hr of neostigmine administration, consider catheterization.
- **Reversal of Nondepolarizing Neuromuscular Blocking Agents**: Monitor reversal of effects of neuromuscular blocking agents with a peripheral nerve stimulator. Recovery usually occurs consecutively in the following muscles: diaphragm, intercostal muscles, muscles of the glottis, abdominal muscles, limb muscles, muscles of mastication, and forehead muscles of the scalp. Closely observe the patient for residual muscular weakness and respiratory distress throughout the recovery period. Maintain airway patency and ventilation until recovery of normal respiration occurs.
- **Toxicity and Overdose**: If overdose occurs, atropine is the antidote.

**Potential Nursing Diagnoses**
- Impaired physical mobility (Indications)
- Ineffective breathing pattern (Indications)
- Pain

**Implementation**
- Oral and parenteral doses are not interchangeable.
- When used as an antidote to nondepolarizing neuromuscular blocking agents, atropine may be used prior to or concurrently with neostigmine to prevent or treat bradycardia.
- PO: administer with food or milk to minimize side effects. For patients who have difficulty chewing, neostigmine may be taken 30 min before meals.

**IV Administration**
- **pH**: 5.0 – 6.5
- **Direct IV**: Administer doses undiluted. May be given through Y-site of an IV of D5W, 0.9% NaCl, Ringer’s solution, or L.R. **Concentration**: 0.5 – 1 mg/mL. **Rate**: Administer each 0.5 mg over 1 min.
- **Y-Site Compatibility**: Heparin, hydrocortisone sodium succinate, palonosetron, potassium chloride, vitamin B complex with C.

**Patient/Family Teaching**
- Instruct patient to take medication exactly as directed. Do not skip or double up on missed doses. Patients with a history of dysphagia should have a nonelectric or battery-operated backup alarm clock to remind them of exact dosage time. Patients with dysphagia may not be able to swallow the medication if the dose is not taken exactly on time. Taking the dose late may result in myasthenic crisis. Taking the dose early may result in cholinergic crisis. Patients with myasthenia gravis must continue this regimen as lifelong therapy.
- Instruct patient with myasthenia gravis to space activities to avoid fatigue.
- Advise patient to carry identification describing disease and medication regimen at all times.

**Evaluation/Desired Outcomes**
- Relief of ptosis and diplopia.
- Improved chewing, swallowing, extremity strength, and breathing without the appearance of cholinergic symptoms in myasthenia gravis.
- Relief or prevention of postoperative gastrointestinal ileus.
- Relief of nonobstructive postoperative urinary retention.
- Reversal of nondepolarizing neuromuscular blocking agents in general anesthesia.

**Why was this drug prescribed for your patient?**