Esmolol HCl

Brand names	Brevibloc, Brevibloc in NaCl, generic
Medication error potential	High-alert medication (adrenergic antagonist and antiarrhythmic) that has an increased risk of causing significant patient harm if used in error.[1] Look-alike, sound-alike drug names. Brevibloc has been confused for Brevital.[2]
Contraindications and warnings	**Contraindications:** Hypersensitivity to esmolol HCl or any component of the formulation. Use of epinephrine may not be effective for anaphylaxis in those receiving beta-blockers.[3] Should not be used in those with severe sinus bradycardia, heart block greater than first degree (unless functional pacemaker), sick sinus syndrome, cardiogenic shock, decompensated heart failure or pulmonary hypertension.[3] **Warnings:** Use cautiously in patients with labile diabetes mellitus as the beta-1 selectivity of esmolol may block hypoglycemia-induced tachycardia and blood pressure changes.[3] Use lowest dose possible in patients with a history of bronchospasm (e.g., asthma) and discontinue infusion if bronchospasm occurs.[3]
Infusion-related cautions	Extravasation may result in serious local reactions, including tissue necrosis, which is more serious following use of the 20-mg/mL product. (See Appendix E.) Thrombophlebitis may also occur. For these reasons, administration via a small vein or through a butterfly catheter should be avoided.[3] Do not use the premixed injection in series connections with plastic containers as air embolism may occur.[3]
Dosage	*Significant hypotension and bradycardia may occur; hence, vital signs should be closely monitored and dosage should be adjusted as needed.* **Antiarrhythmias (supraventricular tachycardia)** **Loading dose:** 500–600 mcg/kg over 1–2 minutes.[3,4] If response is inadequate, a second loading dose of 500 mcg/kg has been given.[5] An 8-day-old with severe tachycardia secondary to neonatal tetanus received a loading dose of 1000 mcg/kg over 1 minute.[7] **Maintenance dose:** The loading dose should be followed by 50 mcg/kg/min.[3] If no response in 4 minutes, increase infusion by 25 mcg/kg/min[3,5] or 50–100 mcg/kg/min[4] q 4 min until >10% decrease in heart rate or blood pressure occurs.[3,4] Although the mean dose for control in one study was 550 mcg/kg/min (range: 400–1000 mcg/kg/min,[4,6] maintenance doses >200 mcg/kg/min have not been shown to significantly increase benefits and are not recommended in *adults*.[3] **Cardioprotection:** The ability of esmolol to protect against myocardial ischemic injury during open heart surgery was investigated in a randomized, double-blind control trial of 30 children (2–72 months of age).[20] Fifteen patients (27.8 ± 26.2 months) requiring surgical repair of ventricular septal defect under cardiopulmonary bypass (CPB) were randomized to receive 50 mcg/kg/min after tracheal intubation, 300 mcg/kg/min during CPB, and 30–50 mcg/kg/min until the end of surgery. Plasma creatine kinase-MB, cardiac troponin 1 were significantly lower than that noted in the placebo group 2 minutes after the end of CPB, at the end of surgery, 4 hours after surgery, and postoperative day 1. Postoperative doses of dopamine were also significantly less in the esmolol group. **Hypertensive crisis/emergency:** *Should not be used to treat hypertension due to the vasoconstriction associated with hypothermia.*[3] *May be administered by direct injection for immediate control.*[3] The goal is to decrease the blood pressure by <25% over the first 8 hours with gradual normalizing over 26–48 hours.[10] **Loading dose:** 500–600 mcg/kg over 1 minute[6,8,9] **Maintenance dose:** There are two approaches: (1) begin with 100–500 mcg/kg/min without a loading dose and titrate to desired blood pressure[8-10]; (2) give loading dose as noted above and begin with 25–100 mcg/kg/min and titrate dose q 5–10 min up to 500 mcg/kg/min[11] or until heart rate or mean blood pressure decreases by at least 10%. Average maintenance dose in *adults* is 100 mcg/kg/min (range: 50–200 mcg/kg/min).[3]

Dosage *(cont.)*	**Postoperative tachycardia/hypertension** **Loading dose:** 125, 200, or 500 mcg/kg over 10–20 seconds.[12] Doses of 200,[13] 750,[13] and 1000 mcg/kg[7] were used in an 18-month-old, a 15-year-old, and an 8-day-old, respectively. **Maintenance dose:** Initial dose of 200 mcg/kg/min should immediately follow the loading dose. Infusion can be increased by 25–50 mcg/kg/min q 10–20 min as needed.[12] One study reported that postoperative cardiac patients required a mean dose of 700 mcg/kg/min to normalize blood pressure and that patients having coarctation repair required larger doses.[15] Although one study noted that larger doses might be necessary when esmolol is used as a single antihypertensive in postoperative tachycardia/hypertension after coarctation repair[13]; others did not report a difference between 3 doses (125, 250, or 500 mcg/kg/min).[12]
Dosage adjustment in organ dysfunction	No dosage adjustment is required in renal dysfunction as <2% is excreted unchanged in the urine.[3,16] Although the half-life of the active metabolite may be increased 10-fold in those with renal failure, accumulation is not clinically important since it has minimal beta-blocking activity.[3] Esmolol has been noted to cause life-threatening hyperkalemia in patients receiving hemodialysis.[3]
Maximum dosage	Although a dose of a 1000 mcg/kg single dose over 1 minute has been given to a neonate[7] and a 6-year-old received 1000 mcg/kg/min,[4] safety of doses above 300 mcg/kg/min has not been studied.[3] Hypotension commonly occurs, especially when doses exceed 200 mcg/kg/min.
Additives	Intended for single patient use as the parenteral product does not contain preservatives.[3] Esmolol in NaCl is also available in premixed bags and ready-to-use vials (20 mg/mL and 10 mg/mL).[3] Although a 15-year old-with cardiomyopathy and ventricular arrhythmias developed delirium that was attributed to the propylene glycol additive in the concentration product (25 mg/mL),[19] this product is no longer available. (See Appendix C for specific information about propylene glycol and potential for toxicity.)
Suitable diluents	D5W, LR, NS, ½NS, D5LR, D5NS, D5½NS, D5R,[3,17] or D5W with KCl 40 mEq/L[3]
Maximum concentration	20 mg/mL (commercially available)[3]
Preparation and delivery	*Parenteral products should be visually inspected for particulate matter and discoloration before use. Refer to appropriate references for more information on compatibility with other drugs and solutions; compatibility following Y-site delivery, and suggested storage and extended stability.*[17] **Stability:** Clear, colorless to light yellow solution.[3,17] A 10-mg/mL solution in suitable diluent is stable for at least 24 hours when refrigerated or at room temperature. Do not freeze.[3,17]
IV push	Given over 1–2 minutes[3]
Intermittent infusion	Not administered by this route
Continuous infusion	10–20 mg/mL[3,17]
Other routes of administration	None reported