

## **PRESCRIBING INFORMATION**

### **Norepinephrine Bitartrate Injection, USP**

1 mg /mL norepinephrine (as norepinephrine bitartrate)

Sterile Solution for Intravenous Infusion

**Sympathomimetic Amine for Use in Hypotensive Emergencies**

Preservative Free

SteriMax Inc.  
2770 Portland Drive  
Oakville ON  
L6H 6R4

Date of Revision:  
July 15, 2024

Submission Control No: 279869

## DESCRIPTION

Norepinephrine (sometimes referred to as *l-arterenol/Levarterenol* or *l-norepinephrine*) is a sympathomimetic amine which differs from epinephrine by the absence of a methyl group on the nitrogen atom.

## ACTIONS

Norepinephrine functions as a peripheral vasoconstrictor (alpha-adrenergic action) and as an inotropic stimulator of the heart and dilator of coronary arteries (beta-adrenergic action). Both of these actions result in an increase in systemic blood pressure and coronary artery blood flow. Cardiac output will vary reflexively in response to systemic hypertension but is usually increased in hypotensive man when the blood pressure is raised to an optimal level. In myocardial infarction accompanied by hypotension, norepinephrine usually increases aortic blood pressure, coronary artery blood flow, and myocardial oxygenation, thereby helping to limit the area of myocardial ischemia and infarction. Venous return is increased and the heart tends to resume a more normal rate and rhythm than in the hypotensive state.

In hypotension that persists after correction of blood volume deficits, norepinephrine helps raise the blood pressure to an optimal level and establish a more adequate circulation.

In *myocardial infarction*, norepinephrine has been shown to increase greatly the patient survival rate. Norepinephrine not only corrects systemic shock (through cardiogenic and peripheral vasoconstrictor action), but also markedly dilates the coronary arteries, thereby increasing coronary blood flow, reducing the area of ischemia and promoting myocardial oxygenation. There is increased venous return and the heart tends to resume a more normal rate and rhythm.

On the coronary arteries, norepinephrine causes about two and one half times the degree of vasodilatation that epinephrine produces and therefore has a greater effect in increasing coronary flow. It has only a slight effect on sugar metabolism, its hyperglycemic action being far less pronounced than epinephrine, and is not contraindicated in diabetic patients.

**NOTE:** With Norepinephrine Bitartrate Injection, USP administration, bradycardia sometimes occurs, probably as a direct result of the rise in blood pressure to normal levels.

## INDICATIONS

Norepinephrine Bitartrate Injection, USP is recommended for the restoration and maintenance of blood pressure in all acute hypotensive or shock states which may result from surgery, trauma, hemorrhage, myocardial infarction, pheochromocytectomy, sympathectomy, spinal anesthesia, septicemia, drug reactions, poliomyelitis and blood transfusion reactions.

Because of the selective peripheral vasoconstrictive action of Norepinephrine Bitartrate Injection, USP, pooled or stagnant blood in the dilated capillaries is driven into the central circulation, thus maintaining vital functions (e.g.-brain, heart, kidneys, etc.)

It may also be useful as an adjunct in the treatment of cardiac arrest and profound hypotension.

## **CONTRAINDICATIONS**

Norepinephrine Bitartrate Injection, USP should not be given to patients who are hypotensive from blood volume deficits except as an emergency measure to maintain coronary and cerebral artery perfusion until blood volume replacement therapy can be completed. If Norepinephrine Bitartrate Injection, USP is continuously administered to maintain blood pressure in the absence of blood volume replacement, the following may occur: severe peripheral and visceral vasoconstriction, decreased renal perfusion and urine output, poor systemic blood flow despite "normal" blood pressure, tissue hypoxia, and lactate acidosis.

Norepinephrine Bitartrate Injection, USP should also not be given in patients with mesenteric or peripheral vascular thrombosis (because of the risk of increasing ischemia and extending the area of infarction) unless, in the opinion of the attending physician, the administration of Norepinephrine Bitartrate Injection, USP is necessary as a life-saving procedure.

Cyclopropane and halothane anaesthetics increase cardiac autonomic irritability and therefore seem to sensitize the myocardium to the action of intravenously administered epinephrine or norepinephrine. Hence, the use of Norepinephrine Bitartrate Injection, USP during cyclopropane and halothane anaesthesia is generally considered contraindicated because of the risk of producing ventricular tachycardia or fibrillation. The same type of cardiac arrhythmias may result from the use of Norepinephrine Bitartrate Injection, USP in patients with profound hypoxia or hypercarbia.

## **WARNING**

Norepinephrine Bitartrate Injection, USP (norepinephrine bitartrate injection) should be used with extreme caution in patients receiving monoamine oxidase (MAO) inhibitors or antidepressants of the triptyline or imipramine types, because severe, prolonged hypertension may result.

Norepinephrine Bitartrate Injection, USP contains sodium metabisulfite, a sulfite that may cause allergic-type reactions including anaphylactic symptoms and life-threatening or less severe asthmatic episodes in certain susceptible people. The overall prevalence of sulfite

sensitivity in the general population is unknown. Sulfite sensitivity is seen more frequently in asthmatic than in nonasthmatic people.

Norepinephrine Bitartrate Injection, USP should be used with caution in the context of aneurysmal subarachnoid hemorrhage (SAH) due to the risk of overdose and associated adverse events. Whenever clinical symptoms rather worsen after the augmentation of blood pressure, reverse hypertensive therapy is advised.

## PRECAUTIONS

*Avoid Hypertension:* Because of the potency of Norepinephrine Bitartrate Injection, USP and because of varying response to pressor substances, the possibility always exists that dangerously high blood pressure may be produced with overdoses of this pressor agent. It is desirable, therefore, to record the blood pressure every two minutes from the time administration is started until the desired blood pressure is obtained, then every five minutes if administration is to be continued. The rate of flow must be watched constantly, and the patient should never be left unattended while receiving Norepinephrine Bitartrate Injection, USP. Headache may be a symptom of hypertension due to overdosage.

*Site of infusion:* Whenever possible, Norepinephrine Bitartrate Injection, USP should be given into a large vein, particularly an antecubital vein because, when administered into this vein, the risk of necrosis of the overlying skin from prolonged vasoconstriction is apparently very slight. Some authors have indicated that the femoral vein is also an acceptable route of administration. A catheter tie-in technique should be avoided, if possible, since the obstruction to blood flow around the tubing may cause stasis and increased local concentration of the drug. Occlusive vascular diseases (for example, atherosclerosis, arteriosclerosis, diabetic endarteritis, Buerger's disease) are more likely to occur in the lower than in the upper extremity. Therefore, one should avoid the veins of the leg or dorsum of the hand in elderly patients, or in those suffering from such disorders. Gangrene has been reported in a lower extremity when Norepinephrine Bitartrate Injection, USP was given in an ankle vein.

*Extravasation:* **The infusion site should be checked frequently for free flow.** Care should be taken to avoid extravasation of Norepinephrine Bitartrate Injection, USP into the tissues, as local necrosis might ensue due to the vasoconstrictive action of the drug.

**Blanching along the course of the infused vein**, sometimes without obvious extravasation, has been attributed to vasa vasorum constriction with increased permeability of the vein wall, permitting some leakage. This also may progress on rare occasions to superficial slough, particularly during infusion into leg veins, in elderly patients or in those suffering from obliterative vascular disease. Hence, if blanching occurs, consideration should be given to the advisability of changing the infusion site at intervals to allow the effects of local vasoconstriction to subside.

Norepinephrine administration was reported to induce fetal bradycardia most likely as a result of uterine/peripheral vasoconstriction by norepinephrine, however transplacental passage cannot be excluded. It was shown to exert a contractile effect on the pregnant

uterus and may lead to fetal hypoxia in late pregnancy. These possible risks to the fetus should therefore be weighed against the potential benefit to the mother.

It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when Norepinephrine Bitartrate Injection, USP is administered to a nursing woman.

**IMPORTANT: Antidote for Extravasation Ischemia:** To prevent sloughing and necrosis in areas in which extravasation has taken place, the area should be infiltrated as soon as possible with 10 to 15 mL of saline solution containing from 5 to 10 mg of phentolamine, an adrenergic blocking agent. A syringe with a fine hypodermic needle is used, and the solution is infiltrated liberally throughout the area, which is easily identified by its cold, hard, and pallid appearance. Sympathetic blockage with phentolamine causes immediate and conspicuous local hyperemic changes if the area is infiltrated within 12 hours. Therefore, **phentolamine should be given as soon as possible after the extravasation is noted.**

Some investigators<sup>1</sup> add phentolamine (5 to 10 mg) directly to the infusion flask because it is believed that the drug used in this manner is an effective antidote against sloughing should extravasation occur, whereas the systemic vasopressor activity of the norepinephrine is not impaired.

Two investigators<sup>2</sup> stated that, in the treatment of patients with severe hypotension following *myocardial infarction*, thrombosis in the infused vein and perivenous reactions and necrosis may usually be prevented if 10 mg of heparin are added to each 500 mL of infusion fluid (5 % dextrose) containing norepinephrine.

Sympathetic nerve block has also been suggested.

## ADVERSE REACTIONS

The following reactions can occur:

*Body As A Whole:* Ischemic injury due to potent vasoconstrictor action and tissue hypoxia.

*Cardiovascular System:* Cardiogenic shock, arrhythmia, bradycardia, probably as a reflex result of a rise in blood pressure, stress cardiomyopathy.

*Nervous System:* Anxiety, transient headache.

*Respiratory System:* Respiratory difficulty.

*Skin and Appendages:* Extravasation necrosis at injection site.

Prolonged administration of any potent vasopressor may result in plasma volume depletion which should be continuously corrected by appropriate fluid and electrolyte replacement therapy. If plasma volumes are not corrected, hypotension may recur when Norepinephrine

Bitartrate Injection, USP is discontinued, or blood pressure may be maintained at the risk of severe peripheral and visceral vasoconstriction (e.g., decreased renal perfusion) with diminution in blood flow and tissue perfusion with subsequent tissue hypoxia and lactic acidosis and possible ischemic injury. Gangrene of extremities has been rarely reported.

Overdoses or conventional doses in hypersensitive persons (eg. hyperthyroid patients) cause severe hypertension with violent headache, photophobia, stabbing retrosternal pain, pallor, intense sweating and vomiting.

### **Reporting Side Effects**

You can report any suspected side effects associated with the use of health products to Health Canada by:

- Visiting the Web page on Adverse Reaction Reporting (<https://www.canada.ca/en/health-canada/services/drugs-health-products/medeffect-canada/adverse-reaction-reporting.html>) for information on how to report online, by mail or by fax; or
- Calling toll-free at 1-866-234-2345.

*NOTE: Contact your health professional if you need information about how to manage your side effects. The Canada Vigilance Program does not provide medical advice.*

## **DRUG INTERACTIONS**

Cyclopropane and halothane anesthetics increase cardiac autonomic irritability and therefore seem to sensitize the myocardium to the action of intravenously administered epinephrine or levarterenol. Hence, the use of Norepinephrine Bitartrate Injection, USP during cyclopropane and halothane anesthesia is generally considered contraindicated because of the risk of producing ventricular tachycardia or fibrillation. The same type of cardiac arrhythmias may result from the use of Norepinephrine Bitartrate Injection, USP in patients with profound hypoxia or hypercarbia.

Norepinephrine Bitartrate Injection, USP should be used with extreme caution in patients receiving monoamine oxidase (MAO) inhibitors or antidepressants of the triptyline or imipramine types, because severe, prolonged hypertension may result.

## **OVERDOSAGE**

Overdosage with Norepinephrine Bitartrate Injection, USP was shown to be associated with severe hypertension, reflex bradycardia, marked increase in peripheral resistance, and decreased cardiac output. These may be accompanied by violent headache, pulmonary edema, photophobia, retrosternal pain, pallor, intense sweating and vomiting. Stress cardiomyopathy was also reported in the context of norepinephrine overdose. In case of accidental overdosage, as evidenced by excessive blood pressure elevation, treatment with

Norepinephrine Bitartrate Injection, USP should be withdrawn and appropriate corrective measures initiated until the condition of the patient stabilizes.

For management of a suspected drug overdose, contact your regional Poison Control Centre.

## **DOSAGE AND ADMINISTRATION**

### **Restoration of Blood Pressure in Acute Hypotensive States**

Blood volume depletion should always be corrected as fully as possible before any vasopressor is administered. When, as an emergency measure, intraaortic pressures must be maintained to prevent cerebral or coronary artery ischemia, Norepinephrine Bitartrate Injection, USP can be administered before and concurrently with blood volume replacement.

*Diluent:* Norepinephrine Bitartrate Injection, USP solution should be administered in 5 % dextrose solution in distilled water or 5 % dextrose in saline solution. These fluids containing dextrose are protection against significant loss of potency due to oxidation. Administration in saline solution alone is not recommended. Whole blood or plasma, if indicated to increase blood volume, should be administered separately (for example by use of a Y-tube and individual flasks if given simultaneously).

*Average Dosage:* Add 4 mL of Norepinephrine Bitartrate Injection, USP solution to 1000 mL of 5 % dextrose solution. Each 1 mL of this dilution contains 4 mcg of Norepinephrine Bitartrate Injection, USP base. Give this dilution intravenously. Insert a plastic intravenous catheter through a suitable bore needle well advanced centrally into the vein and securely fixed with adhesive tape, avoiding if possible, a catheter tie-in technique as this promotes stasis. A drip bulb is necessary to permit an accurate estimation of the rate of flow in drops per minute. After observing the response to an initial dose of 2 to 3 mL (from 8 to 12 mcg of base) per minute, adjust the rate of flow to establish and maintain a low normal blood pressure {usually 80 to 100 mm Hg systolic) sufficient to maintain the circulation to vital organs, in previously hypertensive patients, it is recommended that the blood pressure should be raised no higher than 40 mm Hg below the preexisting systolic pressure. The average maintenance dose ranges from 0.5 to 1 mL per minute (from 2 to 4 mcg of base).

*High Dosage:* Great individual variation occurs in the dose required to attain and maintain adequate blood pressure. In all cases, dosage of Norepinephrine Bitartrate Injection, USP should be titrated according to response of the patient. Occasionally much larger or even enormous daily doses (as high as 68 mg norepinephrine base or 17 vials) may be necessary if the patient remains hypotensive, but occult blood volume depletion should always be suspected and corrected when present. Central venous pressure monitoring is usually helpful in detecting and treating this situation.

*Fluid Intake:* The degree of dilution depends on clinical fluid volume requirements. If large

volumes of fluid (dextrose) are needed at a flow rate that would involve an excessive dose of the pressor agent per unit of time, a more dilute solution than 4 mcg per mL should be used. On the other hand, when large volumes of fluid are clinically undesirable, a concentration greater than 4 mcg per mL may be used.

*Duration of Therapy:* The infusion should be continued until adequate blood pressure and tissue perfusion are maintained without therapy. Norepinephrine Bitartrate Injection, USP infusion should be reduced gradually, avoiding abrupt withdrawal. In some of the reported cases of vascular collapse due to acute myocardial infarction, treatment was required for up to six days.

### **Adjunctive Treatment in Cardiac Arrest**

Norepinephrine Bitartrate Injection, USP is usually administered intravenously during cardiac resuscitation to restore and maintain an adequate blood pressure after an effective heartbeat and ventilation have been established by other means. (Norepinephrine Bitartrate Injection, USP's powerful beta-adrenergic stimulating action is also thought to increase the strength and effectiveness of systolic contractions once they occur.)

*Average Dosage:* To maintain systemic blood pressure during the management of cardiac arrest. Norepinephrine Bitartrate Injection, USP is used in the same manner as described under Restoration of Blood Pressure in Acute Hypotensive States.

## **HOW SUPPLIED**

Norepinephrine Bitartrate Injection, USP is supplied in a sterile aqueous solution in a single-use vial in the form of the bitartrate. Each mL contains 1 mg norepinephrine base and as non-medicinal ingredients: sodium chloride 8 mg, sodium metabisulfite 0.2 mg, and water for injection. The air in the vials has been displaced by nitrogen gas. Norepinephrine Bitartrate Injection, USP is supplied in boxes of 10 vials of 4 mL.

## **STORAGE AND STABILITY**

Store drug product at controlled room temperature 15°-30°C (39°-86°F). **Protect from light and freezing.** Discard unused portion.

**Caution** - Destroy when expired. Parenteral drug products should be inspected visually for particulate matter and discoloration prior to use. Do not use if the solution is pinkish or darker than slightly yellow or contains a precipitate. Store vials inside carton.

Avoid contact with iron salts, alkalis, or oxidizing agents.

## REFERENCES

1. Beard RW. Response of human foetal heart and maternal circulation to adrenaline noradrenaline. *Br Med J* 1962 17;1(5276):443-6.
2. Benzar R, Ahearn G, Mehter H. Iatrogenic norepinephrine overdose resulting in stress cardiomyopathy. *Research snapshot theater: Cardiovascular. Crit Care Med* 2018;46(1):61.
3. Bolli R, Marban E. Molecular and cellular mechanisms of myocardial stunning. *Physiol Rev* 1999;79:609-34.
4. Boon M, Dennesen PJ, Veldkamp RF. A rare stress cardiomyopathy in a patient with Guillain-Barré syndrome. *Neth J Med* 2016;74(2):86-8.
5. Ethgen S, Genay S, Décaudin B, et al. [Major haemodynamic incident during continuous norepinephrine infusion: Beware of the infusion line. An avoidable postoperative hypertensive peak?]. [Article in French] *Ann Fr Anesth Reanim* 2012;31(6):550-2.
6. Frustaci A, Loperfido F, Gentiloni N, et al. Catecholamine-induced cardiomyopathy in multiple endocrine neoplasia: A histologic, ultrastructural, and biochemical study. *Chest* 1991;99:382-5.
7. Girard C, Payen C, Tchenio X, et al. Severe reaction to inadvertent intravenous administration of a large dose of norepinephrine. *Am J Emerg Med* 2010;28(1):113
8. Mann DL, Kent RL, Parsons B, et al. Adrenergic effects on the biology of the adult mammalian cardiocyte. *Circulation* 1992;85:790-804.
9. Martin EA, Prasad A, Rihal CS, et al. Endothelial function and vascular response to mental stress are impaired in patients with apical ballooning syndrome. *J Am Coll Cardiol* 2010;56:1840-6.
10. Ouerghi K, Benchimol H, Gretzinger A, et al. Norepinephrine induced apical ballooning syndrome in resuscitation department. *Archiv Cardiovas Dis Suppl* 2014;6(1):45-6.
11. Paur H, Wright W, Sikkell MB, et al. High levels of circulating epinephrine trigger apical cardiodepression in a  $\beta_2$ -adrenergic receptor/Gi-dependent manner: A new model of takotsubo cardiomyopathy. *Circulation* 2012;126(6):697-706.
12. Quick S, Quick C, Schneider R, et al. Guillain-Barré syndrome and catecholamine therapy. A potential risk for developing takotsubo cardiomyopathy? *Int J Cardiol* 2013;165(3):e43-4.
13. Sampson. J. and Griffith, G.: *Geriatrics* 11:60. Feb. 1956.

14. Sherif K, Sehli S, Jenkins LA. Takotsubo cardiomyopathy after administration of norepinephrine. *Proc (Bayl Univ Med Cent)* 2016;29(2):166-7.
15. Subramaniam A, Cooke JC, Ernest D, et al. "Inverted" tako-tsubo cardiomyopathy due to exogenous catecholamines. *Crit Care Resusc* 2010;12(2):104-8.
16. Taccone FS, Lubicz B, Piagnerelli M, et al. Cardiogenic shock with stunned myocardium during triple-H therapy treated with intra-aortic balloon pump counterpulsation. *Neurocrit Care* 2009;10(1):76-82.
17. Vailas MG, Vernadakis S, Kakavia K, et al. A heartbreaking renal transplantation: Is norepinephrine the culprit to blame? *Transplant Proc* 2016;48(9):3088-91.
18. Yamazaki S, Muraishi M, Makihara Y, et al. A case of takotsubo cardiomyopathy with cardiogenic shock, in which administration of norepinephrine caused adverse effect. *J Card Fail* 2017;23(10):S24.
19. Y-Hassan S. Serotonin norepinephrine re-uptake inhibitor (SNRI)-, selective norepinephrine reuptake inhibitor (S-NRI)-, and exogenously administered norepinephrine-induced takotsubo syndrome: Analysis of published cases. *Int J Cardiol* 2017;231:228-33.
20. Zucker. G. et al.: *Circulation* 22-935. Nov. 1960.
21. LEVOPHED, 1 mg/mL, submission control no. 221383, Prescribing Information. Pfizer Canada ULC. December 20, 2018.