



Prehospital Care Monograph



Dobutamine

Medical Direction Committee
and
Training Division
City of Pittsburgh
Bureau of Emergency Medical Services



Center for Emergency Medicine
OF WESTERN PENNSYLVANIA

**This monograph is dedicated to the professional men and women of the
City of Pittsburgh Emergency Medical Services**

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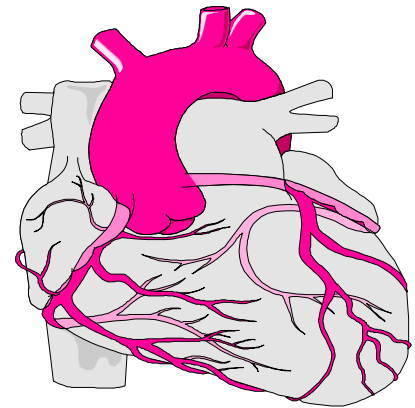
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Dobutamine

This monograph will introduce the drug Dobutamine (Dobutrex®) in preparation for its addition to the Pittsburgh EMS drug armamentarium. Dobutamine will enhance our ability to treat patients with congestive heart failure and cardiogenic shock in the field. Dobutamine has physiological advantages over dopamine in specific instances, especially in patients with congestive heart failure and coronary artery disease.

Background

Dobutamine, along with epinephrine, dopamine, and isoproterenol, are considered sympathomimetic drugs, implying that they mimic the actions of the sympathetic nervous system. These drugs either act directly on the sympathetic nervous system or indirectly by stimulating the release of endogenous catecholamines. Catecholamine is the term used for the above list of drugs which are all chemically similar. While epinephrine and dopamine are naturally occurring substances, isoproterenol and dobutamine are synthetic catecholamines.



In general, the catecholamines stimulate specialized receptors located throughout the body. When stimulated, these receptors cause a specific response in the organ they are located. Receptors can be divided into the following types: alpha receptors, beta receptors and the dopaminergic receptors.

| RECEPTOR | ACTION |
|--------------|---|
| Alpha-1 | powerful vasoconstriction |
| Beta-1 | increased heart rate, increased contractility, increased cardiac automaticity |
| Beta-2 | vasodilatation and bronchodilatation |
| Dopaminergic | dilation of renal, mesenteric, coronary, and cerebral arteries |

The individual drugs vary in degree as to their stimulation of the various receptors. Epinephrine, for example, stimulates both alpha and beta receptors, however epinephrine has a much greater effect on beta receptors. Dopamine acts both on alpha and beta receptors, and in addition when used in low doses acts on the dopaminergic receptors. Dobutamine acts primarily on Beta-1 receptors but has mild action on the Alpha-1 receptors.

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For our purposes we are primarily concerned about the alpha and beta receptors in the heart, systemic blood vessels, and the lungs. Below is a table comparing the effects of alpha and beta receptor stimulation on the heart, blood vessels and lungs.

| ORGAN SYSTEM | ALPHA RECEPTOR STIMULATION | BETA RECEPTOR STIMULATION |
|------------------------|----------------------------|---|
| Heart | No effect | Increased heart rate Increased contractility Increased automaticity |
| Systemic Blood Vessels | Vasoconstriction | Vasodilatation |
| Lungs | Mild bronchoconstriction | Bronchodilatation |

Below is a table comparing drugs with their sympathetic action:

| DRUG | ALPHA STIMULATION | BETA STIMULATION |
|---------------------|-------------------|------------------|
| Epinephrine | ++ | +++ |
| Dopamine, Low Dose | + | + |
| Dopamine, High Dose | +++ | ++ |
| Dobutamine | +/- | +++ |

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Description

Trade Name Dobutrex. A synthetic catecholamine whose primary action results from stimulation of beta-1 receptors in the heart.

Mechanism of Action

Dobutamine via its stimulation of beta receptors in the heart increases cardiac contractility (positive inotropic effect) with little increase in heart rate (chronotropic effect). In addition the stimulation of beta receptors in the blood vessels causes a mild vasodilatory response. This vasodilatation tends to decrease systemic vascular resistance and decrease preload. Dobutamine tends to cause less tachycardia than either isoproterenol or dopamine. Dobutamine increases blood flow to the kidneys and gut by increasing cardiac output. Beneficial effects of dobutamine are that it tends to improve the

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balance between myocardial oxygen demand and supply by increasing coronary blood flow. For this reason dobutamine tends NOT to increase infarct size or precipitate arrhythmias when its titrated to avoid significant increases in heart rate. The duration of action of dobutamine is relatively short with a half life of about 2 minutes. Therefore the actions of the drug will decrease rapidly once a drip is discontinued.

Indications

Dobutamine is useful in treating patients with congestive heart failure and low cardiac output). Dobutamine along with moderate fluid challenges are the treatment of choice in patients with right ventricular infarcts. Dobutamine may also be useful to improve cardiac output in patients with septic shock.

Contraindications

Dobutamine should not be used in hypovolemic shock prior to fluid resuscitation. To increase blood pressure in patients with congestive heart failure and severe hypotension, i.e., bp < 70-80 systolic, dopamine may be the preferred agent.

Precautions

Dobutamine, like all other catecholamines, can cause tachycardia arrhythmias and alterations of blood pressure. Other side effects may include headache, nausea, palpitations, hypotension, and tremor. Paramedics should avoid increasing the heart rate > 10% of baseline while using dobutamine. As with the use of all sympathomimetic drugs paramedics should carefully monitor blood pressure and prepare to treat arrhythmias. Do not mix with sodium bicarbonate or push bicarb through a line running dobutamine.

Other Side Effects

Dobutamine may not be effective when administered to patients already on beta blockers such as Inderal®, which block the beta receptors on which dobutamine acts.

How Supplied

Dobutamine is supplied in 20ml ampules containing 250mg. In general, 1-2 ampules (250-500mg) are placed in a 250 or 500cc bag of D5W or normal saline. The drug is only administered as a drip and **NEVER** administered as a bolus. Dobutamine may be effective at low doses (e.g., 0.5 micrograms/kg/minute). The usual dosage range for Dobutamine is 2-20 micrograms/kg/minute.

Rationale for adding Dobutamine

In general our treatment of congestive heart failure includes increasing oxygenated blood to the heart and decreasing fluid in the lungs. We accomplish this by placing the patient on oxygen and by decreasing the patient's systemic vascular resistance and preload by administering nitroglycerine, morphine, and furosemide (Lasix®). As you well know, nitrates, morphine, and furosemide all cause hypotension. This causes significant problems when the patient is in congestive heart failure **AND** hypotensive. Dobutamine works well in this situation because it increases cardiac output, (increases blood pressure) but decreases systemic vascular resistance and decreases preload. Dobutamine does all of this without increasing myocardial oxygen demand (preventing worsening myocardial ischemia) and with less arrhythmogenic effect than Dopamine. Dopamine, on the other hand, increases preload, increases systemic vascular resistance, increases myocardial oxygen demand and may increase infarct size and arrhythmias.

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Dobutamine may be used **with** Dopamine to gain the added benefit of both drugs together. Both drugs should be started at low doses by separate drips and titrated to effect, i.e., increase blood pressure, increase perfusion, increase patient responsiveness.

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Catecholamines used in prehospital care

| | EPINEPHRINE | DOPAMINE | DOBUTAMINE |
|------------------------------|--------------------|---|--------------------------|
| TRADE NAME | - | Intropin | Dobutrex |
| CATECHOLAMINE | Endogenous | Endogenous | Synthetic |
| RECEPTOR STIMULATION | Alpha and Beta | Low Dose - Dopaminergic Medium Dose - Beta High Dose - Alpha (predominant) and Beta-1 | Beta, Mild Alpha-1 |
| ACTION | | | |
| Systemic vascular resistance | Increase | Increase | Decrease |
| Contractility | Increase | Increase | Increase |
| Blood pressure | Increase | Increase | Increase |
| Arrhythmias | Increase | Increase | Unchanged |
| Heart rate | Increase | Increase | Unchanged |
| Myocardial oxygen demand | Increase | Increase | Decrease |
| Infarct size | Increase | Increase | Unchanged |
| Other | | | Increased cardiac output |

Drug Administration - Sample Calculations

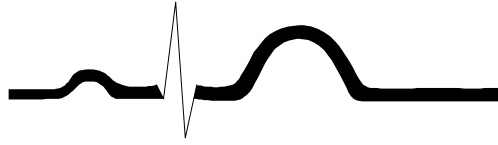
To administer a starting drip of 2 micrograms/kg/minute in a 70kg male, the following scheme could be used:

Place 2 ampules of Dobutamine in the 500 ml bag of D5W or saline (each ampule contains 250mg of Dobutamine) therefore the final concentration in the bag would be 500mg in the 500cc or 1mg/1cc or 1000 micrograms/1cc.

To administer a 2microgram/kg/minute drip in the 70 kg patient, this would require 140 micrograms/minute (70 kg x 2 micrograms/kg/minute).

To convert micrograms to ccs, we must multiply 140 micrograms x 1cc/1000 micrograms, which equals 0.14cc/minute.

Using a 60 drop/cc administration set, we multiply 0.14cc x 60 drops/1cc which equals 8 drops/minute.



Sample Cases

Case #1

Medics are called to the home of a 65 yr old white male with a history of congestive heart failure and myocardial infarction. Upon your arrival you find the patient in moderate to severe distress complaining of shortness of breath and mild chest pain. His wife notes that he slept sitting up in bed the prior evening. His medications include Digoxin, Lasix and potassium. His allergies are penicillin. His past medical history includes myocardial infarction two years ago with several episodes of congestive heart failure over the past year.

On physical exam you find a white male in mild to moderate respiratory distress with cool skin. VS: P=100 R=30 BP=86/p

Physical exam is remarkable for marked JVD, rales 3/4 of the way up in both lung fields and peripheral edema.

Rx This patient's care should include the basics such as insuring the ABCs, placing the patient on O₂, cardiac monitor, and initiating an IV. Since this patient is hypotensive, our usual drugs such as morphine, Lasix and nitroglycerine cannot be used.

In this case, the prehospital care physician may initiate Dobutamine starting at a low dose 0.5 micrograms/kg/minute to increase the patient's blood pressure, cardiac output, and coronary artery perfusion. In addition, the Dobutamine will decrease his systemic vascular resistance and decrease preload, thereby improving his congestive heart failure.

The medics should monitor the patient closely to watch for changes in blood pressure, respiratory status and EKG monitor. The medics should avoid increasing the heart rate > 10 - 20% from baseline, i.e., from 100-120 bpm.

Case #2

Medics are called to the home of a 75 yr old female found by family members with decreased level of consciousness and respiratory distress. They note she has a history of coronary artery disease and was recently complaining of increasing dyspnea on exertion. Her meds include synthroid, Lasix and potassium. Her allergies include morphine.

Physical exam is remarkable for an elderly female in moderate to severe respiratory distress with decreased responsiveness. Her skin is cool and clammy to touch. Vital signs include BP 60/palp; pulse 100 respirations of 30. Pertinent physical exam includes marked JVD, rales 3/4 of the way up both lung fields, good heart tones, and 2+ peripheral edema to the knees.

Rx Once again this patient is hypotensive, and cannot receive nitrates or Lasix. In addition, she is allergic to morphine.

Since this patient is profoundly hypotensive, Dopamine would be the preferred initial agent in this patient (vs. Dobutamine), however the combination of the two medications, i.e., two drips, one of Dopamine, one of Dobutamine, might be an idea.

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Protocol 302-B: Cardiogenic Shock

INDICATION: Patients who meet shock criteria and have historical (chest pain, dyspnea, palpitations) or physical (rales, serious arrhythmia) evidence of cardiac dysfunction/failure.

PROTOCOL:

1. Brief HISTORY, EXAM and VITALS.
2. As soon as shock identified, NOTIFY Medic Command and request EMS Physician response.
3. ASSIST VENTILATION with 100% OXYGEN and INTUBATE if indicated; Nasotracheal route may be useful for awake patients.
4. APPLY EKG MONITOR - if arrhythmia present go immediately to appropriate protocol.
5. INITIATE TRANSPORT as soon as possible.
MAXIMUM permissible on scene time is 10 minutes.
6. ENROUTE:
 - A. Re-assess vitals, mental status, airway & respiratory status, and EKG rhythm frequently.
 - B. Initiate IV:
 - if lungs "wet" or patient has marked dyspnea, start saline lock.
 - if no significant SOB and lungs "clear," give LR 250cc wide open and re-assess patient.
7. Consult Command Physician if not present.

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8. If lungs clear and no significant respiratory distress, continue LR wide open until either perfusion improves, respiratory distress develops or rales heard on lung exam.
 9. If lungs "wet", respiratory distress present or no response to fluid challenge, initiate DOPAMINE DRIP 200 mg IN 250cc D₅W (or 400 mg in 500cc) [this yields 800 mcg/cc] and run at rate per Command Physician. Dose range for shock is 5-20 mcg/kg/min. (Typical starting dose of 10 mcg/kg/min for 80 kg patient would be 60 minidrops/minute.)

AND/OR

DOBUTAMINE DRIP 250mg IN 250ccD5W (or 500mg in 500cc) [This yields 1000mcg/kg/min] and run at a rate per Command Physician. Dose range is 2-

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20mcg/kg/min.