

MEDICATIONS USED IN BARTH SYNDROME

Currently there is no definitive treatment specifically for Barth syndrome. Each clinical manifestation must be treated while being mindful of the disorder as a whole. Some medications may cause a symptom to worsen, therefore be advised that individuals with Barth syndrome should be carefully monitored when starting or stopping any new medications or increasing dosage. Consult with your physician about administration of over-the-counter medications.

Although cardiac disease usually commands the greatest attention in a patient with Barth syndrome, emergent care and immediate evaluation is often required for all fevers, infections, diarrhea and illnesses. The diet of a Barth individual should be carefully monitored for nutritional deficiencies.

MEDICATIONS FOR HEART FAILURE

Heart failure is a general term that describes symptoms one may have when the heart is failing as a pump. The left ventricle no longer functions as an adequate pump to maintain normal cardiac output (normal ejection/shortening fractions). Please see the BSF Heart Failure Fact Sheet for more information.

To treat or prevent symptoms of heart failure, the more common heart medications may include:

- **ACE Inhibitors:** (e.g., *Captopril, Enalapril, Ramipril, Lisinopril, Quinapril, Fosinopril, Benazepril*) – A class of medicines that prevent the body from creating angiotensin, a substance in the blood that causes blood vessels to constrict or become narrow and raise blood pressure. Possible side effects include persistent cough; kidney problems; weakness or dizziness; skin rashes; an altered sense of taste; too-high potassium levels.
- **Diuretics:** (e.g., *Lasix, Hydrochlorothiazide, Chlorothiazide, Furosemide, Bumetanide, Spironolactone*) – A class of medicines used to treat buildup of excess fluid in the body that occurs with congestive heart failure and high blood pressure. Possible side effects include fatigue; too-low blood pressure; poor kidney function; low potassium levels.
- **Vasodilators:** (e.g., *Isosorbide, Dinitrate Hydralazine, Nitrates, Minoxidil*) – A class of medicines that act directly on muscles in blood vessel walls to make blood vessels widen (dilate), allowing blood to flow through more easily, reducing blood pressure. Vasodilators may be used in people who cannot take ACE inhibitors. Possible side effects include fainting or dizziness; headaches; flushing; heart palpitations; nasal congestion.
- **Beta-Blockers:** (e.g., *Carvedilol, Metoprolol, Atenolol, Acebutolol, Bisoprolol, Propranolol*) – Medication used to treat high blood pressure, heart failure, or heart rhythm problems. They reduce the workload of the heart by blocking certain hormones (epinephrine) from binding with beta-receptors in the heart and can help keep rapid heartbeats from being triggered. Possible side effects include less tolerance for physical activity; low blood pressure; asthma symptoms, depression.
- **Cardiac glycosides:** (e.g., *Digoxin*) – A class of medicine used to increase the force or strength of cardiac contraction. It is also used to regulate specific irregularities of heart rhythms. Side effects are usually seen with overdose or when digoxin levels in the blood are too high. Some other medications, such as amiodarone can affect digoxin levels and you should check with your physician regarding drug interactions. Symptoms of digoxin toxicity include confusion; vision problems; loss of appetite; a bad taste in the mouth; nausea or vomiting; impaired kidney function; headaches; skipped heartbeats; rapid breathing.
- **Inotropes:** (e.g., *Milrinone, Dobutamine, Epinephrine*) – A class of medicines that block conduction through the AV node and slow or stop fast, abnormal heart rhythms (*tachyarrhythmias*). These medications are used in a hospital setting for those who require support of heart function through IV medications.
- **Anticoagulants:** (e.g., *Coumadin, Warfarin, Miradon, Anisimidione, Heparin*) – A class of medicines that decrease the blood's ability to clot. Decreased clotting keeps fewer harmful blood clots from forming and from blocking blood vessels. Possible side effects include increased risk of bleeding; easy bruising.
- **Angiotensin II Receptor Blockers:** (e.g., *Losartan, Valsartan, Irbesartan, Candesartan, Eprosartan*) – A class of medicines that block the action of angiotensin II, an enzyme that is responsible for causing the blood vessels to narrow. If the blood vessels are relaxed, your blood pressure is lowered.
- **Calcium Channel Blockers:** (e.g., *Amlodipine, Bepridil, Diltiazem, Felodipine, Flunarizine, Isradipine*) – A class of medicines that reduce the workload of the heart and slow its rhythm by blocking calcium ions from signaling the blood vessels to constrict or tighten. Blood pressure is lowered and circulation is improved. Possible side effects include headaches; facial flushing; dizziness; ankle swelling.

MEDICATIONS FOR ARRHYTHMIAS

An arrhythmia is a generalized term used to denote disturbances in the heart's rhythm. Instead of beginning in the sinus node, the heartbeat could begin in another part of the heart. The heart muscle may develop abnormal beats for many reasons including heart muscle problems, other drugs or medications, problems with blood flow to the heart muscle arteries, etc. The symptoms of an abnormal heart rhythm may include: very fast heart beat or skipped heartbeat; feeling dizzy, faint or lightheaded; shortness of breath; fatigue; palpitations; chest pain; passing out.

- **Antiarrhythmics:** (e.g., *Sotalol, Amiodarone, Dofetilide, Encainide, Flecainide, Lidocaine*) – A class of medicines used to alter electrical conduction in the heart or block impulses that can result in abnormal heart rhythms, or work by blocking substances in the heart that are crucial to its rhythm. Some forms of arrhythmia are resistant to drug therapy alone, and are best treated with implanted devices such as *Pacemaker* or an *ICD (Implantable Cardioverter Defibrillator)*.

MEDICATIONS FOR NEUTROPENIA

Complications in neutropenia are largely preventable by close monitoring of the patient, prompt treatment and use of antibiotics. In Barth individuals who have frequent infections and neutrophil counts persistently below 500, a good response to granulocyte colony stimulating factor (G-CSF) can be achieved. Unlike other neutropenias, bone marrow cells in Barth syndrome respond very well to natural cues including G-CSF. Often low doses are required, which avoids some of the known complications of G-CSF.

The more common medications used for treatment of neutropenia include:

- **Recombinant Human Granulocyte Colony-Stimulating Factor:** (e.g., G-CSF, *Filgrastim*, *Neupogen*)-A protein that stimulates formation and maturation of neutrophils in the bone marrow. G-CSF decreases the chance and the duration of problems due to low white blood cell counts in patients with congenital, cyclic, and idiopathic neutropenia (low white blood cell counts). Most common side effects are headaches & bone pain.
- **Antibiotic:** Medication to stop the spread of an infection.

OTHER COMMON MEDICATIONS FOR BARTH SYNDROME PATIENTS

- **Mitochondrial Cocktail:** (e.g., *Mitochondrial Cofactors* (*Thiamine*, *Pantothenate*, *Riboflavin*, *Nicotinamide*, *Vitamin E*, and *Vitamin C*))- A mixture of vitamins and minerals prescribed on an individual basis depending on the needs of the patients.
- **Coenzyme Q10:** (e.g., *Ubiquinone*)-A fat-soluble vitamin-like substance present in every cell of the body and serves as a coenzyme for several of the key enzymatic steps in the production of energy within the cell and mitochondrial electron transport chain. CoEnzyme Q10 may also function as an antioxidant, depending on the energy status of the cell.
- **L-Carnitine:** (e.g., *Carnitor*)- A physiological substance essential for energy production and for fat metabolism. Despite published claims to the contrary [Ino et al, 1988], no significant benefit has been afforded by supplementation with pharmacological amounts of carnitine. Acute deterioration of cardiac function with increasing mitochondrial dysfunction has occurred several times when a Barth individual was given large doses of carnitine [Ostman-Smith et al, 1994][Kelley, unpublished].
- **Vitamins:** Barth syndrome individuals should take a daily vitamin-mineral supplement to prevent vitamin and mineral deficiencies that can develop on a lower calorie diet.
- **Vitamin C:** (e.g., *Ascorbic Acid*) assists the body in the production of collagen, a basic component of connective tissues. Collagen is an important structural element in blood vessel walls, gums, and bones. It also acts as an antioxidant, scavenging potentially harmful molecules called free radicals
- **Potassium:** A mineral that assists in muscle contraction & maintaining fluid and electrolyte balance in body cells. Potassium is also important in sending nerve impulses as well as releasing energy from protein, fat, and carbohydrates during metabolism. High or low levels of potassium in blood may affect cardiac rhythm. Potassium levels are regulated mainly by the kidney. Diuretics may affect this regulation. Function of the kidney in Barth syndrome patients, as a rule is not affected unless diuretics are prescribed. Prescription of potassium should be dependent on blood levels.

IMMUNIZATIONS

Individuals with Barth syndrome fall into the "high risk" category with regard to infections due to neutropenia. Vaccines are felt to be extremely beneficial for those individuals with neutropenia and Barth syndrome. Please consult with your physician about any known special risks before administering immunizations to individuals who have Barth syndrome.

ADDITIONAL PRECAUTIONS

Certain medications and foods that increase heart rate or change the electrical conduction in the heart should be avoided if possible. These medications include some bronchodilators, antihistamines, antibiotics, some antidepressants, caffeine (chocolate included) and salt substitutes that contain potassium. A list of medications that may increase the risk of ventricular arrhythmia or Prolong the QT Interval can be found at <http://www.qtdrugs.org/medical-pros/drug-lists/printable-drug-list.cfm>. Some herbals and other "alternative" medications contain substances that can adversely affect the heart rhythm. The use of these should be reviewed with your physician. All medications have risks, and the use or termination of any medication should be evaluated carefully by your physician.