Differential Diagnosis: Bradycardia

General Notes:
- The younger the patient the higher the resting pulse generally is. Therefore, the pulse should be put into the proper context of the age of the patient and their clinical status.
- A pulse of < 60 bpm is considered bradycardia in adults, whereas in newborns a pulse < 60 bpm with evidence of low perfusion considered a reflection of a life threatening situation where chest compressions are recommended to be started.

Normal:
- Adults (> 18 yrs of age): 60 – 90 bpm
- 12 yr old: ~ 85 bpm
- 3 – 6 yr old: ~ 100 bpm
- 1 – 2 yr old: ~ 100 bpm
- < 1 yr old: 120 – 130 bpm

Athletes
- *Associations*: Young + otherwise healthy patient + extensive athletic training
- *Pathophysiology*: Not applicable. This is a normal finding.

Beta-Blockers
- *Associations*: History of hypertension +/- atrial fibrillation with rapid ventricular response +/- migraine headaches (for propranolol) +/- stage fright. Medications include: atenolol, bisoprolol, carvedilol, labetalol, metoprolol, propranolol, nadolol, nebivolol.
- *Pathophysiology*: Reduces chronotropy via inhibition of SA Node and AV nodal.

Calcium Channel Blockers (Non-Dihydropyridine; e.g., diltiazem, verapamil)
- *Associations*: History of hypertension +/- atrial fibrillation with rapid ventricular response +/- migraine headaches. This only applies to diltiazem and verapamil and not other dihydropyridine calcium channel blockers such as amlodipine and nifedipine.
- *Pathophysiology*: Slowing of AV nodal conduction in the heart.

Digoxin
- *Associations*: Past medical history of heart failure +/- atrial fibrillation with rapid ventricular response
- *Pathophysiology*: Increase vagal or parasympathetic mediated tone on the AV node, thereby reducing the pulse.

Hypothermia
- *Associations*: Report of cold exposure + change in mental status + impaired coagulation
- *Pathophysiology*: Not completely known but in part due to reduced metabolic demands and increased cholinergic effects on the heart.

Hypothyroidism
- *Associations*: Fatigue +/- weight gain +/- depression +/- hypotension (if severe) +/- hypoglycemia (if severe) +/- hypoglycemia (if severe)
- *Pathophysiology*: Thyroid hormone binds to nuclear receptors in various organ tissues that help to regulate their metabolism and function. Severe hypothyroidism such as seen with myxedema coma can be associated with hypotension, hypothermia, hyponatremia and hypoglycemia.

Increased Intracranial Pressure (ICP)

- *Associations*: Head injury or bleed + hypertension + widening pulse pressure (larger difference between the systolic and diastolic blood pressure).
- *Pathophysiology*: Cushing's triad or reflex (hypertension + bradycardia + widening pulse pressure [increased systolic BP compared to the diastolic pressure) that occurs with rising intracranial pressure (ICP) with resulting impending risk of brain stem herniation.

Lyme's Disease

- *Associations*: Tick bite (recent) +/- presence of a target lesion on skin + heart block on ECG + dizziness or syncope
- *Pathophysiology*: Known to cause significant heart block.

Medications

- *Associations*: Antiarrhythmics (amiodarone, sotalol), Beta-blockers (atenolol, bisoprolol, carvedilol, labetalol, metoprolol, nadolol, propranolol), Non-dihydropyridine calcium channel blockers (diltiazem and verapamil), clonidine, digoxin, sotalol.

Myocardial Infarction

- *Associations*: Chest pain/pressure +/- SOB +/- nausea +/- sweating +/- CV risk factors
- *Pathophysiology*: Decrease blood flow (especially involving the right coronary artery) to heart muscle containing nodal cells that function as a pacemaker.

Sick Sinus Syndrome

- *Associations*: Dizziness +/- syncope + usually in older adult +/- irregular pulse on exam
- *Pathophysiology*: Abnormalities in sinoatrial node impulse formation and propagation within the atrium.

Sotalol (Betapace)

- *Associations*: History of cardiac dysrhythmia requiring antiarrhythmic medications
- *Pathophysiology*: Sotalol is a class III antiarrhythmic medication known to inhibit potassium conduction during phase 3 of the action potential in a ventricular myocyte.

Vasovagal Response

- *Associations*: Usually stressful response/experience + period of hypotension + pale appearance
- *Pathophysiology*: Reduction in sympathetic tone resulting a decreased pulse and blood pressure that temporarily results in a reduction in cardiac output and blood flow to the brain which results in a short period of syncope (usually < 30-60 sec).