Cardiovascular Critical Care Primer
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Introduction/Purpose Statement
Cardiac and vascular diseases are becoming more and more common in American society. Critical care nurses routinely see patients with a wide variety of cardiovascular problems. The purpose of this home study is to increase your understanding of the anatomy, physiology, and pathophysiology of problems such as angina, myocardial infarction, peripheral vascular disease, congestive heart failure, and cardiomyopathy.

Target Audience
This home study was designed for the novice critical care or telemetry nurse. However, other health care professionals are invited to complete this packet.

Content Objectives
1. Identify the normal anatomy and physiology of the cardiovascular system.
2. Describe the pathophysiology of an acute myocardial infarction.
3. Describe the symptoms of heart failure.
4. Describe the pathophysiology of tamponade.
5. Identify the factors that favor the development of a venous thrombosis.
6. Differentiate between dilated, hypertrophic, and restrictive cardiomyopathy.
7. Differentiate between Buerger’s Disease and Raynaud’s Syndrome.

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In order to successfully complete this activity you must read the home study, complete the post-test and evaluation, and submit them for processing.

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Expiration Date for this Activity:
As required by ANCC, this continuing education activity must carry an expiration date. The last day that post tests will be accepted for this edition is December 31, 2020—your envelope must be postmarked on or before that day.

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Contact Hour Information
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<tr>
<th>For completing this Home Study and evaluation, you are eligible to receive:</th>
<th>2.0 MN Board of Nursing contact hours / 1.66 ANCC contact hours</th>
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<td>Criteria for successful completion: You must read the home study packet, complete the post-test and, evaluation, and submit them to TCHP for processing.</td>
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Please see the last page of the packet before the post-test for information on submitting your post-test and evaluation for contact hours.
Peripheral Vascular Disease

As opposed to cardiac or cerebrovascular disease, peripheral vascular disease refers to problems within the blood vessels in the extremities, thorax, and abdomen. The majority of peripheral vascular disease problems are caused by atherosclerosis, just like cardiac and cerebral vascular disease.

Arterial Vascular Disease

There are three major problems that can arise in the arterial vasculature: atherosclerotic occlusion, aneurysm, and embolization.

Atherosclerosis

Atherosclerosis – or arteriosclerosis in the artery – is the primary cause of all vascular problems in the United States. In this process, there is a gradual build up of plaque on the intimal wall of the artery caused by repeated injury, clotting, and scarring.

Problems in the arterial system arise when the amount of plaque build up has grown to such an extent that blood is no longer able to pass easily through the narrowed arterial diameter. This is called arterial insufficiency. When blood cannot pass through at all, it is called arterial occlusion.

The symptoms of arterial insufficiency or occlusion in the arteries that supply the legs (popliteal, aortoiliac, and femoral) are related to the lack of arterial flow. The distal extremity becomes cool, pale or cyanotic, with poor or absent pulses. Pain often accompanies arterial insufficiency because the distal tissues are starved for oxygen. The symptoms of carotid arterial insufficiency result from brain anoxia – ranging from transient ischemic attacks to completed stroke.

Bruit is the sound that is heard when the pressure in the vessel prior to the lumen narrowing is high, and the pressure after the narrowed area is low. The resulting turbulent blood flow causes a low-pitched “whooshing” sound.

Aneurysm

An aneurysm is a weak area in an arterial wall. This weakening can be caused by hypertension, atherosclerosis, smoking, or may be congenital. There are three layers of the artery: the intima, the media, and the adventitia.

Although the most common sites of arterial insufficiency and occlusion are the carotid, renal, popliteal, aortoiliac and femoral arteries, any junction or branching area can develop problems.
Many aneurysms lie dormant without symptoms for years. Other aneurysms can continue to grow in size until their mass causes symptoms or they rupture.

Although any artery can develop an aneurysm, the most dangerous ones are in the aorta. The aorta is the major artery in the body. It branches from the left ventricle and traverses down through the thorax (thoracic aorta) and the abdomen (abdominal aorta), giving off branches to supply all of the body organs with blood.

Symptoms from an aortic aneurysm may include dyspnea, stridor, hoarseness, hemoptysis, cough, or chest pain. All of these symptoms are related to the mass of the aneurysm impinging on other organs. Pain is the main symptom of descending thoracic aortic aneurysm: pain in the shoulder, lower back, abdomen, shoulders, arms, or neck. Finally, abdominal aneurysms usually have no symptoms until they leak or rupture.

Leaking or rupture of an aortic aneurysm is usually a life-threatening emergency. If the wall is weakened enough, the aneurysm will rupture, resulting in aortic blood being pumped into either the chest or abdominal cavity. The patient may bleed to death (exsanguinate) in a very short time. More commonly, patients who complain of severe, unrelenting pain, shortness of breath, faintness, etc., may be experiencing the leaking of blood from the aneurysm.

Similar to aneurysms, an aortic dissection is more common than an aortic aneurysm rupture. A dissection is said to occur when there is a longitudinal split between the intima and the media of the thoracic aorta. A dissection may occur after trauma, or due to Marfan’s syndrome, increasing age, hypertension, or atherosclerosis.

**Embolization**

The third cause of peripheral vascular insufficiency is embolism. An embolus can begin as either a clot formed in the heart or as a piece of dislodged plaque. An embolus will travel through the arterial system until it reaches a branch through which it cannot travel. At that point, the embolus will block blood flow distal to the occlusion.

**Venous Vascular Disease**

The most common form of vascular disease related to the venous system is the development of deep vein thrombosis. Typically found in the lower extremities (particularly the calves), a thrombus occludes venous return to the heart. Pressure backs up from below the thrombus, causing edema to form distal to the occlusion.

The first stage of deep vein thrombosis (DVT) formation is injury. The second stage is intravascular clot formation. If that clot (thrombus) does not become detached and form an embolus, it will adhere to the vein wall within 24-48 hours and eventually be lysed.

The three components needed to cause a DVT are defined in Virchow’s triad:

1. **Hypercoagulability of the blood**: blood dyscrasias, trauma, cancer, estrogen therapy, systemic infection, smoking
2. **Venous stasis**: heart disease (CHF), dehydration, immobility, incompetent leg vein valves
3. **Intimal damage**: trauma, infection, venipuncture, IV infusion of irritant solutions.

**Buerger’s Disease and Raynaud’s Syndrome**

Buerger’s Disease, or Thromboangiitis Obliterans, (TOA) is a rare condition that presents as an inflammation and eventual blockage of the small vessels of the extremities. In rare cases, internal organs are affected. Unlike other vascular diseases, it is neither an embolic nor an atherosclerotic disease. The classic patient is a 20-40 year old smoker, usually male. Non-smoking tobacco users are at risk as well. There is likely a genetic component to it, as it is far more prevalent in certain ethnic groups.

TOA is characterized by reduced blood flow to the extremities, with collateral circulation developing in an ineffective corkscrew pattern (visible on angiogram). Symptoms are related to lack of blood flow: coldness of the extremity, intermittent claudication (pain or cramping that occurs in the legs when walking), and numbness, tingling, and burning sensations. Symptoms start at the tips of the fingers and toes and progress upward. As the disease progresses, there is ulceration of the tips of the digits, and eventually gangrene. Amputation of the digits can only be avoided by abstaining from all forms of tobacco.
Exposure to cold worsens the symptoms. The extremity is sensitive to loss of blood flow caused by elevation above the level of the heart. Care to avoid cold and constricting medications is important. Treatments such as sympathectomies, (a surgical procedure that destroys nerves in the sympathetic nervous system provide only temporary relief, as do vasodilating drugs).

The cause is unknown, but tobacco is thought to be a trigger for an autoimmune or inflammatory process. TOA is often accompanied by Raynaud’s Syndrome.

In Raynaud’s Syndrome, the arterioles of the extremities constrict in response to exposure to cold or stress. There is a cyclical response, with the fingers, toes, and the tips of the nose and ears turning pale due to lack of blood flow. As oxygen is consumed, the color turns to bluish. Then, as the arterioles relax and blood refills, the extremity becomes flushed, and then returns to normal color. Attacks may last minutes or hours.

Primary Raynaud’s occurs with no associated cause, and is generally a milder form, with little pain. Secondary Raynaud’s may be associated with vasoconstricting drugs, frostbite, repetitive motion or vibration injury, smoking, or thoracic outlet syndrome. Secondary Raynaud’s is more painful and may also be associated with Buerger’s disease.

Treatment is generally aimed at control of symptoms. This involves avoiding offending drugs, including caffeine and tobacco. Protection of the extremities by keeping warm in cold weather and when handling cold and frozen objects can prevent attacks. Patients also need to be aware that significant cooling after exercise can trigger an attack, making it important to cool down slowly.

Some drugs, such as topical nitroglycerin, Viagra, ace inhibitors, and calcium channel blockers may relieve symptoms. Open wounds, blackening of the skin, breaks in the skin, and joint soreness surrounding the affected areas need to be evaluated and treated.

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