Hypertension: The Silent Killer
Independent Study Module
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Disclosures:

Requirements for successful completion: read the entire study, complete the post-test with a score of 80% or higher, complete and submit the evaluation form, and complete registration information, including full name and credentials.

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Purpose: The purpose of this study is educational in nature. It is not intended to provide clinical or legal advice or to be a comprehensive compendium on sexually transmitted diseases. For specific implementation information, please contact an appropriate professional, organization, or facility policy.

Objectives:
- Review the physiology of blood pressure
- Describe health issues related to hypertension
Identify nursing measures to enhance blood pressure control

Introduction

Hypertension has been labeled as the “silent killer” because it typically has no warning signs. In the absence of symptoms indicating a health problem, people often do not know they have this potentially deadly condition. Additionally, people who have been diagnosed with hypertension and given a medical plan of care often do not see that adherence to the plan of care makes a difference in how they feel, so they do not take their medications or follow the prescribed regimen. This study describes the problems associated with hypertension, examines the physiologic mechanisms by which blood pressure is controlled, and explores nursing implications for patient teaching and care.

Scope of the Problem

Hypertension is the most common primary diagnosis in the United States today. It is estimated that approximately 72 million adults in the United States today have hypertension (NHLBI, 2008), and many more do not know they have this condition. This is equivalent to approximately one in three people over the age of 18. The Centers for Disease Control and Prevention (CDC, 2008) estimates that the direct and indirect costs of hypertension in the United States will exceed $73.4 billion in 2009. This includes not only the costs related to diagnosis and treatment of the condition but loss time from work and associated personal costs for persons with this diagnosis. Hypertension can lead to numerous cardiovascular problems, such as coronary artery disease, stroke, and heart failure. Hypertension can also lead to renal failure and disruption of other body system functions. While hypertension can be controlled through a variety of means, there is no cure for this condition.

Risk Factors

There are a number of risk factors for hypertension, some of which can be controlled, and some which cannot. Those which cannot be controlled are considered to be “nonmodifiable” risk factors, while those within the control of the person are considered to be “modifiable” risk factors. These are relative terms, however. Persons must be motivated to make personal lifestyle changes and/or adhere to a medical plan of care in order for “modifiable” risk factors to actually be modified.

Those risk factors which are considered nonmodifiable include:
• Age – a man over the age of 45 and a woman over the age of 55 are considered at high risk for development of hypertension
• Race – African Americans have the highest rate of hypertension in the US and also the highest rate of complications related to the disease
• Gender – males have a higher tendency to develop hypertension than do females
• Family history – while a genetic link to hypertension is evasive, there is evidence that hypertension in family members increases one’s risk

These risk factors are considered modifiable:
• Lifestyle – including dietary intake, activity level, smoking, and alcohol use
• Overweight/Obesity – while linked to lifestyle factors, the high proportion of Americans who are overweight or obese has led to this condition being categorized as a separate risk factor for hypertension
• Stress – stress leads to activation of the sympathetic nervous system, which increases blood pressure. Chronic stress interferes with the body’s ability to self-regulate blood pressure control

**Definition of Hypertension**

*The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure - Complete Report (JNC-7)* was published in 2003 and is available in full at [http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.htm](http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.htm). This report significantly alters the previous way blood pressure had been defined. Historically, a diastolic blood pressure above 90 was considered a matter of concern, with less attention to systolic blood pressure, particularly as people aged. The new guidelines consider any blood pressure over 120/80 mmHg a reason for concern. The current standard can be depicted as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic</th>
<th>Modifier</th>
<th>Diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 120</td>
<td>And</td>
<td>&lt; 80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120-139</td>
<td>Or</td>
<td>80-89</td>
</tr>
<tr>
<td>High Blood Pressure Stage 1</td>
<td>140-159</td>
<td>Or</td>
<td>90-99</td>
</tr>
<tr>
<td>High Blood Pressure Stage 2</td>
<td>≥ 160</td>
<td>Or</td>
<td>≥ 100</td>
</tr>
</tbody>
</table>

There are three types of hypertension – essential (or primary), secondary, and idiopathic. Essential or primary hypertension occurs when a person develops hypertension as a condition in and of itself. Secondary hypertension occurs as a co-morbidity with another disease condition or related to another situation. For example, chronic kidney disease or sleep apnea can lead to secondary hypertension. Likewise, some medications can cause blood pressure elevation. Idiopathic hypertension is that which has no known cause.
The Physiology of Blood Pressure

Fundamental to the understanding of hypertension is clear knowledge of blood pressure – what causes it, what maintains it, and what causes it to balloon out of control. This section of the study is devoted to exploration of the physiology of blood pressure.

Blood pressure, technically, is the measure of the force of blood moving through the arteries of the body. Systolic blood pressure is the pressure exerted on the arterial walls as the heart contracts. Diastolic blood pressure is the pressure within the arteries during the heart’s rest period, the ventricular filling process.

Cardiac output is a factor in regulation of blood pressure. This is a combination of heart rate plus stroke volume. Blood is propelled into the arterial system by the pressure exerted by the left ventricle when it contracts. The rate of the pumping action, plus the amount of blood pushed out from the heart with each contraction, creates the cardiac output.

Once the blood is in the arteries, the resistance of those arteries also affects blood pressure. Such factors as the length of the blood vessel, the diameter of the vessel, and the smoothness of its walls all contribute to resistance. Partially occluded vessels have a narrower diameter; vasoconstriction causes higher pressure to be required to push the blood through the artery.

The thickness, or viscosity, of the blood is also a factor in blood pressure regulation. Conditions such as anemia reduce the viscosity of blood, because there are fewer solid bodies compared to the liquid component in the blood. High blood sugar increases the viscosity of blood. Think about pouring maple syrup out of a container – the flow is slow because the fluid is thick. High viscosity results in higher blood pressure. Sometimes, when the fluid is thick, you squeeze (constrict) the container, increasing the internal pressure to force the fluid out.

In a non-hypertensive patient, and in the normal course of daily events, various internal mechanisms carry out their regulatory processes quietly and efficiently, with no awareness on the part of the person. However, failure in one part of the system can cause compensatory efforts in other parts of the system and over time can lead to failure of one or more of the mechanisms that regulate blood pressure. Medications to treat blood pressure are designed to work on one or more of these regulatory processes.

Nervous System Control Factors
The parasympathetic nervous system is responsible for “normal” regulation of the functions of the body, including maintenance of blood pressure. The parasympathetic nervous system regulates the vagus nerve, and stimulation of the parasympathetic nervous system serves to decrease the heart rate, thus contributing to lower blood pressure.

The sympathetic nervous system is responsible for supporting the body during periods of stress, either intrinsic (occurring within the body, such as disease) or extrinsic (happening outside the body, such as fear of job loss). Under action of the sympathetic nervous system, the body prepares for “fight or flight” maneuverability. This includes such phenomena as dilation of pupils in the eye, increase in heart rate and contractility, increased respiration, and vasoconstriction, pulling more blood into the central organs of the body.

Antidiuretic hormone (ADH) is secreted by the hypothalamus. This substance is released in response to activation of baroreceptors in the cardiovascular system. It stimulates retention of water, which increases blood pressure by increasing cardiac volume. One of the effects of alcohol intake is to decrease the effect of ADH, resulting in increased renal output and therefore lower blood pressure.

**Cardiovascular Control Factors**

There are baroreceptors in the walls of the carotid sinus, aortic arch, and right atrium which monitor pressure. Chemoreceptors in the same areas monitor oxygen and carbon dioxide levels. These receptors signal the brain to stimulate the parasympathetic nervous system or the sympathetic nervous system as needed for internal regulation of homeostasis, including stability of blood pressure.

Additionally, changes in the vascular system, such as decrease in elasticity of vessel walls or obstruction, can cause an increase in blood pressure. Often these changes occur gradually, requiring regular vigilance in monitoring the blood pressure, even for someone who typically has a “normal” blood pressure.

Calcium in the heart muscle is released by electrical stimulation of the muscle and is an essential component in cardiac contractility. Calcium in the peripheral vascular system is also important in controlling contractility of blood vessels.

**Renal System Control Factors**
The renin-angiotensin mechanism is important in homeostatic regulation of blood pressure. The juxtaglomerular cells in the kidneys secrete renin. Secretion of renin increases in response to a number of factors, including reduced renal perfusion, decrease in circulating blood volume, increase in activity of the sympathetic nervous system, and low potassium levels (McPhee and Papadakis, 2008). Renin acts on angiotensinogen, a substance produced in the liver, to facilitate development of angiotensin I. Angiogensin converting enzyme (ACE) is used in the conversion of angiotensin I to angiotensin II. This substance causes constriction of blood vessels, increasing blood pressure and thereby reducing the flow of blood to the kidneys. As blood flow decreases, renal perfusion decreases and less water is excreted. Fluid retention, in turn, leads to an increase in cardiac volume, which increases the blood pressure.

In response to the action of angiotensin II, the adrenal cortex releases aldosterone. This substance stimulates sodium retention and excretion of potassium. Sodium retention supports fluid retention, also increasing cardiac volume and blood pressure. When the blood pressure rises, the renin-angiotensin mechanism action diminishes, maintaining homeostasis in the body.

**Diagnosis**

Hypertension cannot be diagnosed based on a one-time blood pressure reading. Some people suffer from what has been referred to as “white coat syndrome”, meaning that the stress of being in the medical office in and of itself causes the blood pressure to rise. To avoid an inappropriate diagnosis of hypertension, most sources recommend that the blood pressure be above recommended levels on at least two to three visits to the healthcare provider. Ideally, these visits should occur at approximately the same time of day and under similar circumstances (same amount of time since last meal, same amount of time since leaving work, etc.).

There are guidelines for appropriate measurement of blood pressure. Following these guidelines on a regular basis will help in effective monitoring.

1. Advise the patient to avoid smoking, drinking alcohol, or ingestion of caffeine in the 30 minutes prior to the time the blood pressure will be taken.

2. Ask the patient to empty his/her bladder before taking the blood pressure.

3. Be sure the cuff size is appropriate. Blood pressure cuffs are available in pediatric, adult, and large sizes. The bladder portion of the cuff should cover at least 80% of the
circumference of the arm. A cuff that is too small will result in a falsely high reading; a cuff that is too large will result in a falsely low reading.

4. Have the person sit in a chair with his/her feet on the floor. Posture should be erect but comfortable. The person should ideally be seated and encouraged to relax for at least five minutes before the blood pressure is taken. (There are times when it is important to also check the blood pressure when a person is standing, but baseline blood pressures should be taken with the person in a sitting position.)

5. Support the arm which is being used for the blood pressure measurement. The arm should not be hanging loose. Position the arm in a relaxed position on a chair arm or nearby table so that the arm is at heart level.

6. Position the cuff correctly. Follow the instructions for the particular type of equipment being used. Be sure the equipment is calibrated according to the directions.

7. Listen carefully with an appropriate stethoscope. Note the reading where the first sound is heard (systolic reading) and the point at which the sound disappears (diastolic reading).

Patients can be taught to take their own blood pressures. Often home monitoring is extremely helpful in addressing the “white coat” hypertension challenge, because it offers a comparison between what the patient’s reading is in a more relaxed environment and the more stressful healthcare provider’s office. If a person is going to be doing home monitoring, it is helpful to have him/her bring the equipment to the office so you can teach the patient with the actual equipment that will be used at home.

Some people like to monitor their blood pressure at kiosks set up in shopping malls, airports, and other public areas. While there is no inherent harm in this process, accuracy of the reading cannot be assured.

A person doing self-monitoring should keep documentation of the blood pressure reading, time of day, any particular circumstances that might be influencing the blood pressure at that particular time, and any changes to the normal monitoring process (such as a reading from a public kiosk as opposed to the usual home monitoring equipment). Sharing this documentation with the healthcare team helps to provide a picture of the day-to-day status of the persons’ blood pressure.
Treatment

The goal of treating blood pressure goes far beyond measuring numbers of systolic and diastolic pressure. Reduction in morbidity and mortality by decreasing the negative effects of hypertension on the body, particularly in the cardiovascular and renal systems, is critical. Both lifestyle modifications and medications play key roles in achieving this goal. It is generally recommended that patients be followed on a monthly basis while a therapeutic plan is being implemented, then be seen every 3-6 months after the target blood pressure has been achieved (NHLBI, 2003).

Lifestyle Modifications

There are both medical and lifestyle interventions which can impact hypertension. For some persons, one approach or the other can be used alone. For most people, a combination of lifestyle modification and pharmacologic therapy is most effective.

Lifestyle factors are the most critical, because they are inexpensive, do not require medical prescriptions, and have the greatest potential for long-term and lasting results. Lifestyle factors, do, however, require a significant commitment on the part of the person. Unfortunately, many people feel that they have not received their “money’s worth” if they leave the healthcare provider’s office without a prescription. Additionally, many people believe that the purpose of medicine is to “fix” their problems without them having to make any personal investment in making things better.

Lifestyle changes have been proven to be effective in controlling hypertension for many people. These include increasing or maintaining an adequate level of physical activity, monitoring dietary intake, effectively managing stress, smoking cessation, and moderation in the consumption of alcohol.

Physical activity is a recommendation for everyone, whether or not diagnosed with hypertension. Americans in general have a very sedentary lifestyle, which has led to rising levels of overweight/obesity and associated chronic diseases. The general recommendation is for at least 30 minutes of physical activity per day. This can include such things as climbing stairs, walking from a parking lot into a store, and cleaning house. Physical activity does not need to be an expensive endeavor, though some people find an investment in a good pair of walking shoes to be helpful. Running or jogging is not necessary, and in fact is not recommended for everyone. However, most people are able to sustain some level of walking for up to 30 minutes
per day. For those who are resistant to outdoor walks, one suggestion might be to walk with a friend. Another option is to rescue a dog from the pound – daily walks will benefit both!

The DASH eating plan has been recommended as a healthy eating plan for everyone, but particularly for those with hypertension. The acronym DASH stands for Dietary Approaches to Stop Hypertension. Note that this is referred to as an “eating plan” and not a “diet”. The term “diet” has a negative connotation for many people and is a good word to avoid when teaching people about healthy eating. The DASH plan encourages intake of fruits, vegetables, and whole grains, while minimizing fats and red meats. The focus is on foods high in fiber, protein, vitamins, and minerals. The value of nutrition in blood pressure control cannot be underestimated. The JNC-7 report states that “A 1600 mg sodium DASH eating plan has effects similar to single drug therapy” (p.7).

Smoking cessation is always worthy of discussion with patients. For those who have smoked for many years, cessation may be perceived as “impossible” or “not an option”. However, revisiting the topic at health care appointments allows the patient to reconsider options. There are numerous strategies that have been used for smoking cessation, ranging from “cold turkey” personal behavior to medication to hypnosis. There is no one strategy that works for everyone, and many people state that they have tried several methods before finding the one that works for them. For those who choose not to quit smoking, decreasing the frequency of smoking has been found to have some benefit.

There are mixed messages in the public media, as well as in healthcare literature, about alcohol consumption. Some sources recommend total abstinence, while others suggest that alcohol in moderation may have some physiological benefit (for those who are not alcoholic). Moderation typically means two or fewer drinks per day for men and a maximum of one drink per day for women.

Much has been written in both professional and lay publications about effective management of stress. While people respond differently to stressors, a few general concepts are applicable to everyone. Stress causes activation of the sympathetic nervous system, which, in addition to other things, increases blood pressure to prepare the body for “fight or flight”. When stress is unresolved, the sympathetic nervous system and parasympathetic nervous system work to attempt homeostasis. When this process fails, the body becomes fatigued from trying to sustain balance, and chronic hypertension results. Some strategies that people have found to be beneficial for reducing stress are physical exercise, specific relaxation techniques and/or deep breathing, and implementation of programs such as Tai Chi or yoga. Some people find reading, quiet mediation, prayer, or listening to music effective tools for stress reduction. Rather than
prescribing a specific stress management strategy, the healthcare provider is better served by working with the patient to develop a plan that fits in his/her lifestyle and personal preferences.

**Medications**

Several classifications of medications are used in the treatment of hypertension. The type of medication used is dependent on the desired physiologic effect. Often a combination of medications is more effective than one medication alone. Medication, combined with lifestyle modification, is often recommended for most effective management of high blood pressure. More aggressive monitoring and treatment is recommended for persons with diabetes and chronic renal disease (McPhee and Papadakis, 2008), because of their increased risk for negative systemic effects resulting from hypertension.

The following is not meant to be a comprehensive review of blood pressure medications. It is intended to emphasize various types of antihypertensive medications that act in unique ways to influence the physiologic factors that contribute to elevated blood pressure.

**Diuretics** have probably been used longer than any other type of medication for blood pressure control. By encouraging excretion of water and sodium, diuretics decrease blood pressure by decreasing circulating blood volume. Depending on the particular type of diuretic prescribed, the patient may need to have electrolytes, particularly sodium and potassium, monitored regularly. As more sophisticated and targeted medications have become available, many prescribers have moved away from use of diuretics. However, these medications, many of which are available in generic form and are thus less costly to patients, have been found to be just as effective as newer, more expensive medications. Current standards recommend use of diuretics, either alone or in combination with other medications, as a front-line treatment of hypertension.

**ACE Inhibitors** prevent the production of angiotensin II, which causes vasoconstriction. When this substance is blocked, there is more arterial vasodilation, lowering the blood pressure. ACE inhibitor drugs are identifiable in that their generic names end in “pril”. These medications are highly recommended as either first-line or combination therapy for many with hypertension, including those who have diabetes and heart failure (McPhee and Papadakis, 2008). While the drug is effective for many people, a common and very irritating side effect is a dry cough. For some, this issue is something that can be dealt with; others require a change in medication to eliminate this troublesome problem.
Beta blockers can be identified by the “olol” suffix in the generic name. Beta blockers work on the beta receptors in the heart and vascular system to decrease the heart rate and decrease cardiac output, thereby decreasing the blood pressure. There are some metabolic effects which can be troublesome, such as worsening breathing for persons with chronic obstructive pulmonary disease or asthma and masking symptoms of hypoglycemia and increasing blood glucose levels in persons with type 2 diabetes (McPhee and Papadakis, 2008). Some persons, particularly those who are first starting beta blocker therapy, may experience bradycardia and hypotension, leading to dizziness and possibly falls. Persons who desire to stop beta blocker therapy, or prescribers who choose to stop this therapy, should decrease the medication gradually rather than stopping it suddenly, as rebound hypertension can occur.

Calcium channel blockers (generic drugs end in “dipine”) cause vasodilation. Calcium ions are released by microfibers in the cardiac and peripheral vascular muscles and work to stimulate muscle contraction. Blockage of this mechanism causes relaxation of the muscles in the vasculature, therefore lowering the blood pressure. Common side effects are a result of the vasodilation – flushing, headache, and peripheral edema (McPhee and Papadakis, 2008).

Aldosterone receptor blockers interfere with the actions of aldosterone in regulating sodium and potassium levels. Typically aldosterone aids in retention of sodium and excretion of potassium, so blockers would allow sodium to be excreted and potassium retained. Increased sodium, and therefore fluid, excretion allows for decreased blood volume and consequently decreased blood pressure. Clearly a side effect to watch for is hyperkalemia.

Combination drugs are often used to achieve maximum control. It is not unusual for a person to be on a combination of calcium channel blocker and ACE inhibitor, beta blocker and diuretic, or any other combination. It is sometimes difficult for patients to understand why they need more than one medication to control their condition. Helping people realize the different physiologic functions of the types of medications will assist in a person’s willingness to adhere to the plan of care.

Nursing Implications

Persons with hypertension need extensive support in learning to live with a chronic disease. Because the condition itself has no symptoms, the patient needs ongoing validation of the value of the treatment plan. Reinforcement that the blood pressure is under control will stimulate the patient to continue the therapeutic regimen. When changes in the plan of care are needed, explanations of the rationale for the change and the expected value of the new plan must be clarified.
The best plan in the world will not help the patient unless it is followed. Adherence to a plan of care tends to be better if the patient is actively involved in developing the plan instead of just being told what to do. For example, rather than telling a patient to get 30 minutes of exercise per day, the nurse might explore with the patient what types of exercise, if any, the patient currently does, what he enjoys, and what might be logically added to the person’s daily routine to increase the amount of exercise.

Medication monitoring is a critical part of nursing care (Dumont and Hardware, 2009). The patient needs to understand the medications, how and when they are to be taken, and what therapeutic effects are expected. Side effects should be explained, and the person should be advised to contact the healthcare provider if untoward symptoms develop. Often a dosage adjustment can aid in effective therapy, but patients who do not understand this may just decide on their own to stop taking a drug if it is producing undesirable effects. Rapid withdrawal of some antihypertensives can result in significant negative effects, so patients should always be advised to work closely with the healthcare provider when considering changes in the medication regimen.

Cost of medications is also an issue for many people. Explore with the patient what resources are currently being used to cover the costs of medications. Many pharmaceutical companies have programs to help those who are otherwise unable to afford their prescriptions. The nurse can also talk with the prescriber about the possibility of changing the medication regimen to less costly medications.

The JNC-7 report (NHLBI, 2003) indicates that prescribers often fail to use a multi-drug therapeutic approach to controlling blood pressure, even when it is clear that a one-drug approach is not effective. This behavior is referred to as “clinical inertia”. The nurse can be an advocate for the patient in talking with the prescriber about possible adjustments to the plan of care. In fact, the report states (p. 20) that “Involvement of nurse clinicians and pharmacists can be helpful” in promoting an effective treatment plan.

Nurse case managers have been used in some settings to follow patients with hypertension and other chronic conditions. Data suggests that patient adherence to a plan of care is much higher when patients perceive that support is available, that someone is truly interested in seeing that the patient’s needs are being met, and that someone is able to trouble-shoot when problems occur.
There are many resources available to assist people on their personal journey toward hypertension control. Both professional and consumer educational and support materials are available to assist persons in addressing the topic of hypertension.

This disease can have extremely negative effects on a huge number of Americans. However, with proper monitoring, education and care, persons with hypertension can reduce their risks and continue to have productive lives. Nurses have a key role to play in teaching about prevention, monitoring, and caring for patients with hypertension.

References


Selected Resources

American Heart Association. www.americanheart.org
American Society of Hypertension. www.ash-us.org
Center for Disease Control and Prevention. www.cdc.gov
Hypertension Education Foundation. www.hypertensionfoundation.org