

URINARY TRACT INFECTIONS

Abstract:

Urinary tract infections are often painful during urination and create feelings of discomfort, such as urgency and frequency to urinate. Conditions involving the urinary tract include infection of the kidney, bladder, urethra and inflammation of the bladder is the most common. If the bacteria spreads to the kidney, the affected person develops symptoms that include a fever, pain in the back or side below the ribs, nausea, or vomiting. Kidney infections need to be treated quickly, are more serious than bladder infections and less common. Women more than men are affected by urinary tract infections. The condition is treatable and typically resolves very quickly.

Learning Objectives:

1. Identify the signs and symptoms of a urinary tract infection.
2. Identify the risks and complications of a urinary tract infection.
3. Identify the therapies used to treat urinary tract infections.
4. Identify methods use to prevent urinary tract infections.

Introduction

Urinary tract infections can involve the urethra, bladder, and kidneys. Generally, the body is able to defend against a urinary tract infection, however when it fails there are common symptoms. A kidney infection is the most serious of urinary tract infections, and can involve one of both of the kidneys and are often painful and will lead to worse health problems if untreated. Types of urinary tract infection are discussed in the following sections, and the focus will be on the diagnosis and treatment of bladder infections.

Overview of Cystitis

A urinary tract infection (UTI) is a common medical problem. The correct term for a urinary tract infection of the bladder is *cystitis*. The term urinary tract infection is frequently thought of as an infection of the bladder. This is because infections in the urinary bladder are the most common infection of the urinary tract. However, infections can happen in other parts of the urinary tract.

The elderly and women are particularly susceptible to urinary tract infections. Urinary tract infections are also a common problem for people who have an indwelling urinary catheter and for people who are hospitalized. They do occur in men, children and infants but not as often.

In young, healthy adults, an infection of the urinary tract is uncomfortable but it is a problem that responds well to treatment. A urinary tract infection in an older person or someone who is immunocompromised can lead to serious complications.

Cystitis is one of the most common infections of the urinary tract and in the career of a certified nursing assistant (CNA) there will be many patients who will be treated for this problem. Infections of the kidneys and of the urethra, pyelonephritis and urethritis, respectively are not presented here. The terms cystitis and urinary tract infection will be used interchangeably and the other types of urinary tract infections will be discussed.

Urinary Tract and Renal System: Anatomy and Physiology

The urinary tract and the renal system are, in a sense, one and the same. The urinary tract and the renal system are both composed of the kidneys, the ureters, the urinary bladder, and the urethra. When these organs and body structures are functioning as the urinary tract, they perform the relatively simpler tasks of forming, storing, and excreting urine. However, when these same organs and body structures are working as the renal system, they perform some very complex tasks.

The renal system is one of the most important organ systems. The renal system helps maintain the proper internal environment of the body, the optimal conditions under which the brain, heart, lungs and other organs function best. The renal system functions to

- Eliminate potentially toxic wastes.
- Help regulate blood pressure.
- Assist in maintaining the normal acid-base level in the body.
- Control the blood volume and fluid volume.
- Assist in the formation of red blood cells.

- Help to control the blood level of electrolytes such as calcium, potassium, and sodium.

Each of these functions of the renal system is critically important. If a person's renal system is unable to function properly and eliminate toxic wastes, survival of the person for any appreciable length of time is impossible. If the renal system cannot help maintain a normal acid-base balance, then the cardiovascular system, the neurological system, and even the renal system itself, will not function properly.

A person with an impaired renal system cannot form a sufficient amount of red blood cells and, consequently, that person will suffer from anemia. A normally functioning renal system and urinary tract is essential; a person cannot survive without them. Although the urinary tract is much simpler in what it does when compared to the renal system, if a person's kidneys, bladder, *etc.*, are not able to form, store, and excrete urine, the person cannot survive.

A review of the descriptions of the organs and structures of the renal system and urinary tract are discussed next.

The Kidneys

There are two kidneys. They are located in the abdominal cavity, below the lower edge of the rib cage and slightly above the hip bones, one on the right side and one on the left. The kidneys are supplied with blood by several large arteries and although the kidneys are not very large in comparison to some other organs, they receive over 20% of the blood that is pumped from the heart. The kidneys receive such a high percentage of the cardiac output because they are metabolically active,

and because they are so metabolically active they need a lot of blood and oxygen to function. Because of this, the kidneys are *very* sensitive to any decrease in their blood supply.

Each kidney is comprised of an outer layer called the cortex and an inner layer called the medulla. The basic functional unit of the kidney is called the *nephron*, and the nephrons are located in both the cortex and the medulla. Blood from the body flows into the kidneys and through the nephrons, and each nephron has a filtering unit - the glomerulus - and a system of tubules. As blood flows through the nephron, the glomerulus, and the tubules, fluid is reabsorbed back into the blood as needed and what is not reabsorbed is excreted as the urine. The nephrons, glomerulus, and tubules are also where electrolytes, acids, bases, and other substances can be reabsorbed or excreted as needed. The urine that is formed in the nephrons moves into a collecting area in the center of the kidney called the renal pelvis and from there it flows into the bladder.

The kidneys are highly complex organs and, as mentioned previously, they are metabolically active and need a lot of blood and oxygen. The primary functions of the kidneys are listed as follows.

Elimination of Toxic Wastes

Normal metabolism produces compounds and by-products that are inherently toxic and must be eliminated, and this is one of the primary functions of the kidneys. Blood from the body enters the kidneys and into the nephrons. The nephrons filter and remove toxic wastes from the blood and these are then excreted in the urine. The two most important toxic products eliminated by the kidneys are blood urea

nitrogen (BUN), and creatinine. Blood urea nitrogen and creatinine are by-products of metabolism and of the breakdown of protein. Blood urea nitrogen and creatinine must be removed from the blood and excreted in the urine as high levels of these compounds can be harmful. The importance of the BUN and creatinine will be discussed in more detail in a later section.

Regulation of Blood Pressure

The kidneys help to regulate blood pressure in two ways. The first is by controlling blood volume. If the blood pressure is too high or too low they can increase or decrease the amount of urine that is formed as blood flows into the kidneys, thus eliminating or conserving body fluid. The second is by a system of blood pressure sensors in the kidneys. These sensors respond to the level of blood pressure - too high or too low - by releasing an enzyme called renin that helps control blood pressure.

Maintaining Acid-base Balance

Acids and bases are produced by metabolism, and the correct balance between the two must be maintained - and maintained within very narrow parameters. If the balance between the two swings too far in one direction or the other (too many acids or too few bases, for example), many of our organ systems cannot function properly. The kidneys help maintain a normal acid-base balance by excreting or reabsorbing acids, excreting or reabsorbing bicarbonate (the most important base) or by producing new bicarbonate.

Red Blood Cell Formation

Red blood cells contain a compound called hemoglobin. Hemoglobin is the carrier molecule for oxygen. When a person inhales, the oxygen in the air that is breathed in moves into the blood circulating through the lungs and attaches to the hemoglobin in the red blood cells. As blood circulates through the body, oxygen detaches from hemoglobin and is delivered to the organs and tissues. The kidneys produce a hormone called erythropoietin that stimulates the bone marrow to produce red blood cells. Without a sufficient supply of erythropoietin, someone will develop anemia.

Electrolytes

There are many electrolytes in the blood, for example, calcium, potassium, and sodium. The kidneys help maintain the optimal concentration of electrolytes in the blood by reabsorbing them or excreting them in the urine as needed.

Regulating Blood and Fluid Volume

This function of the kidney was discussed above, but in the context of blood pressure control. The amount of blood and fluid in the body is also important for normal organ and tissue functions. For example, if the amount of body fluid and blood is decreased, dehydration exists and the heart and the lungs will have to work harder to circulate blood and deliver oxygen, and organs and tissues may not be adequately perfused.

The kidneys are enormously important organs, and they are very metabolically active. If the supply of blood and oxygen is significantly decreased by hemorrhage, hypotension, toxins, or any other factor, the kidneys can suffer irreversible damage and this can have serious implications.

The Bladder and Ureters

The bladder collects and stores urine. The capacity of the bladder is approximately 300-350 mL, although it can hold more. The walls of the bladder have several layers, and one of these layers is the detrusor muscle. As urine accumulates in the bladder, the bladder walls are stretched and nerve endings in the bladder wall are stimulated. Stimulation of these nerve endings sends a signal to the detrusor muscle to contract, and the bladder is emptied.

Urine exits the bladder via the urethra. The urethra is a narrow tube that starts at the bottom of the bladder and ends in an opening called the meatus. In males the urethra is part of the renal system and the reproductive system.

Urinary Tract Infections

The term urinary tract infection was mentioned previously as generally referring to an infection in the urinary bladder, but the correct term for this infection is *cystitis*. Although cystitis is the most common infection of the urinary tract, urinary tract infections can also occur in the kidneys and in the urethra.

Populations at Risk for Cystitis

Cystitis is a very common infection. Approximately 25-40% of all women in the United States have had cystitis at one point in their lives, and some authorities feel that the lifetime incidence of cystitis in women is much higher - up to 50%. In addition, many women have cystitis that can be easily treated but the infection keeps returning, which is a

condition called *recurrent* urinary tract infection. Cystitis is the most common infection seen in the outpatient setting, for example, primary care physicians' offices, outpatient clinics, *etc.*

Cystitis is also very common in the elderly, in hospitalized patients, and it is especially common in hospitalized patients who have an indwelling urinary catheter. Urinary tract infections account for approximately 40% of all hospital-acquired infections, and approximately 80% of those infections occur in patients who have an indwelling urinary catheter. Having an indwelling urinary catheter in place for longer than seven days increases by a factor of seven the risk for developing cystitis, and if the catheter is in place for 30 days or longer cystitis is almost ensured.

Cystitis does occur in men, but it is rare for a man who is less than 50 years old to develop this type of urinary tract infection. Males 50 years of age and younger are approximately 30 times less likely to develop cystitis than are women, and the incidence of cystitis in men only equals that of women after age 60. After age 50, the incidence of cystitis in males begins to increase, mainly due to specifics of the male anatomy. An enlarged prostate and the development of infections related to male anatomy such as epididymitis, prostatitis, and orchitis may occur.

Cystitis and Women

There are many reasons why women develop cystitis far more often than do men. Although some women have specific risk factors that account for the development of cystitis and make them more likely to

develop this infection, most cases of cystitis happen in healthy women who have structurally normal urinary tracts.

The basic reason why cystitis occurs in men and women is that bacteria from the perineal region enter the urethra and travel up the urinary tract to the bladder. This puts women at a high risk for the development of cystitis for several reasons. The female urethra is much shorter than the male urethra, and the bacteria have less distance to travel to reach the bladder. The female perineal area also has more bacteria than the male, and the urethra is closer to the rectum. Sexual intercourse allows bacteria to enter the urethra, and the use of spermicidal jellies and/or diaphragms during sexual intercourse increases the risk of bacteria being introduced into the urethra.

Recurrent urinary tract infection is a persistent problem for many women. If a woman has more than two episodes of cystitis in six months or more than three in one year, she is considered to have recurrent urinary tract infections. Recurrent urinary tract infections are a common problem. For any woman who develops cystitis there is a 25% chance she will have a recurrence within six months and a 46% chance she will have another episode of cystitis within a year.

It is not known why some women develop recurrent urinary tract infections. It may simply be that these women are exposed to a higher level and frequency of risk factors such as frequent sexual intercourse or the use of a diaphragm and/or contraceptive jelly. There is also the possibility that even after successful treatment with antibiotics, a small amount of bacteria remain in the wall of the bladder. The natural immunity and defensive mechanisms of the body may keep the bacteria

at a low level, too low to cause cystitis, but if the immune system is slightly depressed or more bacteria enter the bladder then a urinary tract infection could occur.

Cystitis and Urinary Catheters

The presence of an indwelling urinary catheter is a very big risk factor for the development of cystitis. It was mentioned earlier that if an indwelling urinary catheter is in place for 30 days or longer, a urinary tract infection is almost inevitable. There are several reasons why indwelling urinary catheters are such a huge source of urinary tract infections.

The first reason is the presence of the catheter itself. Having a urinary catheter in place disrupts the integrity of the urinary tract. It also removes one of the body's defense mechanism against cystitis. Bacteria can enter into the urethra, but urination will often physically flush them out before they can reach the bladder and this is not possible if a catheter is in place.

Poor placement technique of the urinary catheter is another reason why urinary catheter-associated infections are common. Placing an indwelling urinary catheter must be done using sterile technique, and studies have shown that many catheterizations are performed using substandard sterile technique. The next reason is improper use. There are specific circumstances in which an indwelling urinary catheter should be used. Examples of these are: 1) during prolonged surgery, 2) in critically ill patients who need accurate measurement of intake and output, and 3) acute urinary retention due to obstruction. There are other situations in which an indwelling catheter is an important and

necessary intervention, but the important point is that patients should only be catheterized when there is an appropriate need and unfortunately that is not always the case.

It has been estimated that up to 55% of all urinary catheter placements are inappropriate - there is no approved need - and decreasing the number of catheterizations will obviously decrease the number of urinary tract infections. When considering that many people who are catheterized may have risk factors such as advanced age, diabetes, or a depressed immune system, it is very clear that an indwelling catheter must only be placed when it an absolute necessity.

Poor catheter care is responsible for a large number of urinary tract infections. Good urinary catheter care begins with record keeping, and this means that the date and time of the insertion should be documented. This would seem to be a simple idea. But numerous studies have shown many hospitals and health care facilities do a poor job in recording the date and time of catheter insertion. Considering that the risk of developing a urinary tract infection increases with the duration of placement, it is clearly very important to know how long a urinary catheter has been in place.

Poor adherence to good standards of urinary catheter care can also lead to urinary tract infection. These standards include proper bag and catheter positioning, cleaning the insertion site, and maintaining the sterility of the system. Unfortunately, breaches of these standards are relatively common and often result in a urinary tract infection. Proper care of an indwelling urinary catheter will be discussed in a later section.

The presence of a urinary catheter is itself a risk for developing cystitis. However, approximately 15 percent of all urinary catheter-associated infections that occur in a healthcare facility are caused by bacteria that have come from another patient, and there is only one reason why this happens - poor hand washing technique by the staff. It has been estimated that almost 69% of all catheter-associated urinary tract infections are preventable.

Cystitis and Men

Up until age 50, cystitis is rare in healthy men. The urethra is much longer in men (8 inches/20 centimeters) than in women (1.5 inches/4 centimeters). Prostatic fluid contains zinc, and zinc has the ability to kill bacteria that can cause cystitis. Also, the opening of the urethra is not as close to the rectum as it is in a woman. If a man under the age of 50 develops cystitis, there is a good chance that he has a structural abnormality of the urinary tract or a kidney stone.

After age 50, the incidence of cystitis in men increases. This is due somewhat to an increase in risk factors common to men and women, medical conditions such as diabetes, neurological conditions such as Alzheimer's or dementia that affect personal hygiene, or immobility. It can also be due to the development of an enlarged prostate gland or caused by infections that are specific to men. These infections are epididymitis, orchitis, and prostatitis. Cystitis is more common in men who are uncircumcised.

Risk Factors for Cystitis

Regardless of age or gender there are risk factors that increase the chances of developing cystitis.

- Diabetes
- Dehydration
- Immobility
- Previous urinary tract infections
- Fecal and/or urinary incontinence.
- Conditions such as Alzheimer's or dementia that affect personal hygiene
- Kidney stones: The medical term for kidney stones is nephrolithiasis

Signs and Symptoms of Cystitis

In most people, the signs and symptoms of cystitis are fairly recognizable. Most people will report painful urination and frequency, among other symptoms that are listed here.

- **Dysuria:**
Dysuria is the medical term for pain while urinating. The pain is caused by bacteria in the urine irritating the urethra.
- **Frequency:**
People who have a urinary tract infection have a persistent need to urinate, and they must urinate many times during the day. Even after the bladder has been emptied, someone who has cystitis will feel the urge to urinate a short time later.
- **Urgency:**
Cystitis produces a sensation of urgency - the need to urinate happens very quickly and cannot be ignored. Someone who has cystitis will feel the need to urinate immediately: they cannot wait.
- **Hematuria:**
Hematuria is the medical term for blood in the urine.

- Pain in the area of the bladder or pain in the lower abdomen.
- Foul smelling urine.

The signs and symptoms of cystitis can be very uncomfortable and inconvenient. However, if someone has a simple case of cystitis, the person will not be terribly sick and should be able to perform most normal activities, albeit with some interruptions. But if someone has the typical signs of cystitis and feels too sick to work and/or has symptoms such as chills, a high fever, or severe pain, these are indications that the infection may be more than a simple case of cystitis.

Cystitis can happen to people who are unable to report the symptoms. If this is the case, patients who are susceptible to cystitis need careful observation of their voiding patterns and general health.

Cystitis happens quite frequently to patients who have an indwelling urinary catheter, but because of the presence of the catheter, dysuria, frequency, and urgency cannot be used as diagnostic signs. In that case, determining the presence of a catheter-associated urinary tract infection can be difficult. But healthcare workers should remember that these infections are more likely to happen to certain people (for example, the elderly, people who have diabetes, people who have had the catheter in place for seven days or longer), so close observation of at-risk populations can be helpful in detecting a catheter-associated urinary tract infection. Also, if the urine of a patient who has an indwelling urinary catheter is bloody, cloudy, or foul smelling, or if the patient has a fever, a catheter-associated urinary tract infection should be suspected.

Diagnosis of Cystitis

Most of the time diagnosing cystitis is straightforward, and it is done by using the patient's signs and symptoms, and an examination of the urine. The patient who has cystitis will have many of the signs and symptoms listed in the previous section, and these are strongly suggestive of cystitis. A urine sample will be examined and if the patient has cystitis, there will be bacteria, blood, and white blood cells in the urine. The urine sample may also be sent to the laboratory for a test called a urine culture and sensitivity. The urine is placed in special medium and after a period of time it is examined to see what bacteria are present (the culture) and what antibiotics the bacteria are susceptible to the culture.

If the patient has an indwelling urinary catheter, the urine sample can be collected by aspirating urine from the collection port on the catheter tubing. If the patient does not have an indwelling urinary catheter, a midstream, clean catch urine sample will need to be provided. The procedure for obtaining a midstream, clean catch urine sample is outlined below.

- Instruct the patient to wash the hands.
- Provide the patient with antiseptic towelettes.
- Male patients are instructed to wipe the end of the penis in a single motion – do not clean in a back and forth motion. Repeat the cleaning with the second towelette.
- Female patients are instructed to separate the labia and then wipe from front to back, using a single motion, using both towelettes.
- The patient should begin to urinate into the toilet. Once the urinary stream is established, stop the stream and then urinate into the specimen cup.

- Make sure to tell the patient that the inside of the cup and the inside of the lid are sterile and should not be touched.

If the patient does not have an indwelling urinary catheter and is not able to provide a midstream, clean catch urine sample, it may be necessary to temporarily insert a catheter into the bladder to obtain a specimen. This is commonly called straight catheterization.

A urine sample and a urine culture are typically the only tests that are used to diagnose cystitis. If it is suspected that the infection may have moved from the bladder into the kidney or that the cystitis was caused by a physical abnormality in the urinary tract or by a kidney stone, the physician may order a renal ultrasound, an intravenous pyelogram (a contrast study), or insert a cystoscope into the urinary tract to visually examine the urethra and the bladder.

Treatment of Cystitis

Cystitis is treated with antibiotics. Most cases are treated with Bactrim[®], Macrobid[®], or Keflex[®]; the generic names for these drugs are, respectively, trimethoprim/sulfamethoxazole, nitrofurantoin, and cephalexin. Cipro[®] (ciprofloxacin) and Levaquin[®] (levofloxacin) may also be used. The usual course of therapy is about seven days, and many people have significant relief from the symptoms in a day or two.

Some physicians will also prescribe Pyridium[®] (phenazopyridine) for patients who have cystitis. This medication is not a cure for cystitis, but it is very effective at decreasing the symptoms of burning, frequency, and urgency. Patients who have cystitis should be instructed to drink lots of fluid, to complete the full course of the antibiotics, and

to call the physician if the signs and symptom do not improve or worsen, or if they develop chills, fever, or other signs of a serious infection.

Complications of Cystitis

Most cases of cystitis in young, healthy adults can be easily treated with antibiotics. But cystitis can spread to other parts of the urinary tract, and if this happens the patient will have signs and symptoms such as chills and shaking, confusion or drowsiness, fatigue, fever, nausea and vomiting, severe pain, or pain in the lower back.

Cystitis can also be the source of a very serious medical condition called *sepsis*. Sepsis happens when an infection in one part of the body such as the lungs or the urinary tract spreads to the bloodstream. The presence of the bacteria in the blood causes a severe, generalized inflammation, and this in turn causes a very high fever, hypotension, mental status changes, and other significant clinical signs. Urinary tract infections account for approximately 25% of all cases of sepsis, and the elderly are particularly vulnerable.

Recurrent cases of cystitis can cause pyelonephritis and renal scarring, and urinary tract infections that progress to kidney infections in pregnant women can cause premature labor.

Prevention of Cystitis

Prevention of cystitis in people who do not have an indwelling urinary catheter can be difficult. Most of the preventative strategies that have been recommended are for women, as they are more susceptible to cystitis. The conventional interventions for the prevention of cystitis and the prevention of recurrent urinary tract infections include the use

of 1) cranberry juice, 2) staying well hydrated, 3) voiding after intercourse, 4) bathing or douching, 5) urinating frequently, 6) vitamin C supplements, 7) avoiding bubble baths, and 8) using proper perineal hygiene. However, the latest research indicates that cranberry juice may have a slight preventative effect, but this has not been proven and the other methods mentioned are not effective at preventing cystitis.

Some of the methods of prevention of cystitis for which there is good evidence for effectiveness include:

- Changing the method of contraception. If a sexually active woman is using a diaphragm and contraceptive jelly, changing to a different form of birth control may be helpful.
- Post-coital antibiotics. Women who suffer from recurrent cystitis can prevent urinary tract infection by taking an antibiotic after intercourse. Women who have more than three episodes of cystitis per year are considered candidates for prophylactic antibiotic therapy to prevent cystitis recurrence.
- Prophylactic antibiotics. Some physicians will prescribe daily doses of antibiotics for the prevention of cystitis, and in certain women this approach is successful.
- Intravaginal estrogen. In postmenopausal women, an intravaginal estrogen suppository has been shown to decrease the incidence of cystitis.

Patients should always consult with a physician before using the preventative methods that were listed above. These methods may not always be safe; for example, cranberry juice can increase the anticoagulant effects of Coumadin[®] (warfarin), a very commonly used blood thinner.

Prevention with an Indwelling Urinary Catheter

Preventing a catheter-associated urinary tract infection is challenging, but it can be done. The first step is to understand and use basic methods of infection control, and one the most important and effective of these is handwashing. Handwashing has been recognized by the Centers for Disease Control and Prevention (CDC) as the most important way to prevent the spread of infection. As regards catheter care, handwashing should be done before starting patient care, when hands are visibly soiled, after contact with a patient, after contact with any body secretions, and before and after putting on gloves. Handwashing and barrier protection (gloves) prevent contact cross transmission of microorganisms from the care provider to the patient or between patients, affecting the patient who has an indwelling urinary catheter.

Specific methods for preventing catheter-associated urinary tract infections include using alternatives to indwelling urinary catheters, such as condom catheters, and an indwelling urinary catheter should only be inserted if there a need for one to be used. There should be clearly documented guidelines that address the issues of insertion and discontinuation of an indwelling urinary catheter, as well as guidelines for catheter care. These include 1) the date and time of urinary catheter insertion should be documented, and 2) chart review should be done periodically on patients who have an indwelling urinary catheter in order to determine the length of placement.

Cleaning the catheter insertion site is essential. This should be done at least once a day or according to the guidelines of the healthcare facility for specific instructions on how often to do this and for any

specific way the procedure should be done. The basics of the procedure are: 1) wash the hands before starting, 2) wear gloves, and 3) clean the area using soap and water. Especially for female patient, the caregiver should make sure to clean from the front towards the back to avoid contaminating the catheter insertion site with bacteria from the rectal area. Soap and water alone is sufficient; antibacterial soaps or solutions do not provide any advantage nor do antibacterial ointments applied to the area.

Maintaining the sterility of the urinary drainage system is standard practice. The outside of the indwelling catheter system should be clean, but it is not considered sterile. The inside of the catheter, the inside of the drainage bag, and the connection between the catheter and the drainage bag are considered areas that must be kept sterile. The best way to maintain the sterility of the system is to keep the system closed; the catheter should not be disconnected from the drainage bag tube. If the catheter is disconnected from the collecting tubing, the tip of the catheter or the collecting tubing should not be touched. Gloves should be used before reconnecting the catheter and the tubing. A certified nursing assistant (CNA) involved in catheter care where the catheter and tubing has been disconnected should immediately notify a nursing supervisor.

The caregiver should maintain proper position of the catheter, the drainage bag, and the collecting tube. The drainage bag should be below the level of the bladder. This will promote drainage and prevent urine from sitting in the collection tubing or moving back into the bladder. The bag should never touch the floor. The collecting tubing should be positioned so that kinks or loops will not develop; these can allow urine

to pool and this will increase the risk of an infection. The catheter should be secured to the patient's leg or abdomen and it should be secured so that there is no traction or tension on the catheter. Tension or traction of an indwelling urinary catheter can be painful, and it can cause trauma and/or an infection. Securing the catheter will also prevent it from being accidentally pulled out.

The catheter can be secured using commercially available devices or improvised methods, and it should be secured to either the upper thigh or the abdomen. Some authorities recommend that indwelling urinary catheters should be secured to the abdomen if the patient is male; however, the policy of the workplace should be checked. In either case, the catheter attachment and the integrity of the skin where it is attached must be checked at least once every 8 hours.

Urine Collection

The urinary drainage bag should be emptied once every 8 hour shift or when the amount of urine in the bag reaches a certain level that will be specified by your workplace guidelines. Wash your hands, put on gloves, do not touch the drainage bag opening, and drain the urine into a clean container that is used for that patient alone. Notice of the color of the urine, of blood and/or excessive amounts of sediment, of the amount of urine collected, and documentation of these observations should be done.

Case Study: Urinary Tract Infection

The following case study was obtained from a PubMed search and discusses complications arising after insertion of an indwelling bladder

catheter. The authors reported on a 61-year-old woman who was medically evaluated after 2 days of decreased to no urine output, fever, poor appetite, and progressive decline in mental status.

The patient's medical history included cerebral palsy, and neurogenic bladder without diabetes or hypertension. She was treated with an indwelling bladder catheter to relieve urinary retention for ten years. The patient was not prescribed medication. She had been evaluated at home by primary care and was admitted to the hospital because of fever with a disturbance of consciousness. On examination, she was evaluated as confused. Her temperature was 37.8°C, blood pressure 151/81 mmHg, heart rate regular at 95 beats per minute, percutaneous oxygen saturation 96% (room air), and respiratory rate 26 per minute. Her respiratory examination was unremarkable and her abdominal examination revealed no chronic liver disease or tenderness in the suprapubic area. A large, nontender cystic mass was palpable in the suprapubic region. Of note, the patient had reported suprapubic discomfort earlier on.

A neurologic examination revealed that the patient was slow to answer questions and to follow commands, and she was hard of hearing. She could not provide a reliable medical history or report symptoms, such as whether she had a headache or stiff neck. She had an indwelling urinary catheter and drainage bag, however there was no urine output.

Laboratory testing at the time of admission showed a urinalysis that revealed an infection with numerous bacteria, and other abnormal levels such as the presence of white blood cells in the urine. The patient's blood test showed a high white blood cell count that revealed infection, and she had other laboratory blood test markers that revealed inflammation.

A head computed tomography (CT) and magnetic resonance imaging (MRI) for change in consciousness showed no basis for a neurological condition, and her chest CT showed she had no lung infection. Abdominal CT and ultrasonography, however, revealed abnormal bladder changes, such as kidney and bladder swelling and thickening, however, no signs of liver disease.

The authors diagnosed the patient with *sepsis* on the basis of the patient's vital signs and neurological conditions, and a bladder catheter exchange was performed. The indwelling bladder catheter on admission was obstructed by blood clots. Two blood samples and one urine sample were obtained for cultures before antibiotic treatment was started. Approximately 10 hours later, the patient had an increase in her temperature (39.8°C), her systolic blood pressure was critically low at 60/30 mmHg, heart rate elevated at 120 beats per minute, and increased respiration rate at 30 per minute; she appeared gravely ill.

Intravenous volume resuscitation was started and she was given emergency rescue medication that included a continuous intravenous infusion of noradrenaline, and methylprednisolone was administered

intravenously to address septic shock symptoms of low blood pressure and inflammation.

Volume resuscitation, cardiovascular support, antimicrobial (antibiotic) administration, and bladder catheterization were continued. Seven days after admission, two blood cultures, blood clots culture, and one urine culture detected an offending organism causing the infection (*Proteus mirabilis*). Antibiotics that effectively treated this organism included penicillin types and broad spectrum antibiotics such as levofloxacin. The patient's level of consciousness and general condition improved rapidly and she received rehabilitation before discharging on the 28th hospital day.

Discussion

The authors diagnosed the patient as having a case of encephalopathy (swelling of the brain) due to infection and without a history of liver disease. The patient had an elevated blood ammonia level without the typical causes identified.

Several bacteria can produce ammonia in the blood. Researchers have reported on bacteria found from a urine culture due to a urinary tract infection in humans. Some of these bacteria are widely distributed in soil and water, and the increased production of ammonia can enter the blood circulation, causing swelling of the brain.

The patient in this case had an obstruction that led to a urinary tract infection and this condition caused elevated levels of blood ammonia. Obstruction to urine flow can result from interior or exterior mechanical blockage with fixed occlusion of the drainage system.

Urinary stagnation in a chronically distended bladder may also lead to ammonia levels increasing in the blood circulation, and causing encephalopathy.

An indwelling bladder catheter to reduce urinary retention was continued in the patient because of neurogenic bladder during home care. Two days of no urine flow in her medical history and bladder fullness with wall thickness in spite of having the indwelling bladder catheter suggested obstruction of the indwelling bladder catheter.

To prevent obstructive urinary tract infection it is necessary for care providers to observe urine-flow and urine symptoms carefully. In particular, an indwelling bladder catheter should be replaced regularly by a skilled clinician in a safe environment. To manage indwelling bladder catheter it is important for care providers to prevent health care-associated infection due to indwelling bladder catheter during home care.

In this case, septic shock developed with elevated ammonia levels caused by an obstructive urinary tract infection because of an indwelling bladder catheter blockage. Management of an indwelling bladder catheter is important to prevent obstructive urinary tract infection. Additionally, regular lab testing of blood ammonia should be measured for patients with a urinary tract infection and consciousness disturbance. The treatment of this patient led to the recovery of her mental status and her blood levels returned to normal.

Summary

The body is generally able to defend against an infection of the urinary tract. When a urinary tract infection occurs it can involve the urethra, bladder, and kidneys. Urinary tract infections are often painful during urination, and a sense of urinary urgency and frequency to urinate are usual signs that an infection exists. Bacteria that spreads to the kidney, may result in fever, pain in the back or side below the ribs, nausea, or vomiting. A kidney infection is the most serious of urinary tract infections, and need to be treated quickly. The condition is treatable and typically resolves very quickly.

Urinary tract infections are a common problem for people who have an indwelling urinary catheter and for people who are hospitalized. They occur in men, children and infants, however, women and the elderly are the most susceptible to urinary tract infections. Obstructive urinary tract infection can occur with an indwelling bladder catheter, and to prevent this condition it is necessary for the catheter to be regularly and safely replaced. Prevention of healthcare associated infection due to an indwelling bladder catheter involves determination of whether the catheter was needed and basic steps to maintain a urinary catheter system from the time of catheter insertion and throughout management of the catheter drainage system and patient care.