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An 85-year old Caucasian female presented to the Emergency Department of St. Mary's Hospital on April 19, 2015 after being rescued from a nursing home fire. The patient suffered both thermal burns and smoke inhalation injuries as a result of the fire, which occurred yesterday. The patient, who lived in the independent living portion of the nursing home, was independent and able to perform activities of daily living before this hospitalization due to severe thermal burns and smoke inhalation injuries. She had a history of pneumonia and bronchitis amongst other acute disorders, as well as the chronic comorbidities of type 2 diabetes mellitus (DM) with diabetic neuropathy, chronic obstructive pulmonary disease (COPD), and coronary artery disease (CAD). Despite these conditions and increased risk for poor lung function, this patient had been stable and compliant with her drug regimens prior to her most recent injuries. However, this patient had a 25 pack-year history of smoking and past alcohol abuse. At the time of her rescue, the patient was going into acute respiratory distress syndrome (ARDS) and had a notably decreased level of consciousness. This patient's admitting diagnoses of thermal burns and smoke inhalation injuries will be discussed including their various etiologies, specific clinical manifestations, associated lab values to be monitored, and treatments focused specifically on nursing care.

A burn is defined as an injury to body tissue by way of chemicals, radiation, an electric current, or heat. Heat in excess is the most common cause as fires and boiling water bring most patients into the hospital for care. The extent of a burn depends on the temperature, duration of contact with the cause, and type of body tissue (Knighton, 2014). For example, a burn on the face has a higher chance of causing significant scarring and pain compared to the same vesicant burning the dorsal surface of the arm. In this case, it would be the type of body tissue that determined the extent of this burn as the face is more vascular and has more nerve endings compared to the dorsal surface of the arm. This patient's burns were located mostly on her lower extremities and back as she was sleeping when the fire spread up the end of her bed. It was concluded that this patient was unable to notice the fire for at least an hour or two due to her decreased sensation to heat and pain as a result of diabetic neuropathy (Lazear, 2014).

Burns are also typified as being thermal, chemical, electrical, or related to the inhalation of smoke. The type is dependent on the primary cause. Thermal burns, such as this patient's, involve things such as flames, scalding water, or contact with heat-producing agents like cosmetic appliances. Alkalis, acids, and organic compounds make up the common contributors to chemical burns. Electrical burns can cause patients to have life-threatening interior complications such as dysrhythmias and damage to vessels or nerves. Since the damage from electrical burns is mostly internal, yet potentially lethal, electrical burns are characterized by what is called the iceberg effect. Similarly, the inhalation of smoke can cause injuries to a patient's upper or lower airway in addition to causing metabolic asphyxiation, which is what most building fire survivors die from. Patients with smoke inhalation injuries need to be monitored for pulmonary edema and signs of acute respiratory distress syndrome (ARDS). A decrease in the level of consciousness and an altered mental status are early signs of hypoxia resulting from smoke inhalation injuries (Knighton, 2014). This patient was going into ARDS and had a decreased level of consciousness at the time of her rescue. As documented by the emergency personnel at the scene, the patient's saturated oxygen level was 75% while her respiration rate was 9 breaths per minute (12-20 breaths per minute). Her low saturated oxygen level and respiration rate were at critical values that indicated oxygenation was inadequate and cardiac issues were quite likely to begin (Eisel, 2014). Furthermore, this patient's severe thermal burns also contributed to her current hospitalization.

Classifications of burns are decided upon by assessing each one's severity, which is measured by their extent, location, depth, and associated risk factors specific to the patient (Knighton, 2014). As previously mentioned, this patient's burns were considered severe. The extent of her burns, measured by a burn guide such as the Rule of Nines, was determined to be about 25%, which is counted as severe. The Rule of Nines divides the body into multiples of nine and the burned sections are added up to equal the total body surface area (TBSA) (Sommer et al., 2013). Burn classifications also include the specified degrees of superficial partial-thickness, deep partial-thickness, and full-thickness, or first, second, and third degree respectively (Knighton, 2014). This patient's burns were classified as deep partial-thickness and full-thickness due to their associated clinical manifestations. This patient's burns were identified as severe since her TBSA was over 15%, level of consciousness decreased, and need for hydration significant.

Superficial partial-thickness burns, or first-degree burns, are ones that go through only the top layer of skin (Knighton, 2014). This top layer, called the epidermis, is avascular and provides a water-resistant protection for the body. The integumentary system is another name for skin, which is also considered an organ. Fed by blood cells in the dermis, the epidermis is composed of both a dead portion on the surface and the living portion that connects the surface to the dermis. The majority of epidermal cells are keratinocytes, which regenerate about once a month. In the regenerative process, these cells, which start off undifferentiated, keratinize and move to the skin's surface to make up the stratum corneum (Dirksen, 2014b). This regenerative process occurs normally when skin is not damaged, but also occurs at the time of healing for superficial partial-thickness burns.

The clinical manifestations of a superficial partial-thickness burn include: pain, moderate to severe tenderness, redness, minimal edema, and blanching (Knighton, 2014). An example of a superficial partial-thickness burn is sunburn or minor scalding from hot water. This type of burn is less likely to scar since there is no blistering or eschar and typically heals within three to six days (Sommer et al., 2013). Also, the majority of patients with superficial partial-thickness burns do not require hospitalization because dehydration is not a concern and large-scale treatment options are unnecessary. Instead, treating superficial partial-thickness burns involves symptomatic care using cooling devices and topical analgesics. Care should be taken to avoid direct sun exposure as well as other agents that could lead to additional burning or burn-related complications (Knighton, 2014). This patient's burns were not classified as superficial partial-thickness because they surpassed the epidermis and delved deep into the dermal layer of her skin. Also, this patient required hospitalization due to her severe TBSA percentage and significant amount of deeper thermal burns along with smoke inhalation injuries.

Deep partial-thickness burns, or second-degree burns, have damage to the entire epidermis and on into the dermis. These burns are characterized by blisters, or blebs, hypersensitivity to touch or air, moderate to severe pain, moderate edema, blanching, and a mottled white, pink, or cherry-red appearance (Knighton, 2014). Scarring is likely to occur with these burns that heal from the outside in and the bottom up within 10 to 21 days. The key to promoting the healing of these burns is keeping them moist, or free from desiccation. However, skin grafting is a treatment possibility depending on the factors of healing involved for each patient (Sommer et al., 2013). For example, this patient is 85-years old with a substantial smoking history and documented past of skin cancer. Therefore, this patient's chances of healing without a skin graft are less likely compared to a robust 20 year-old non-smoker who stays out of the sun during the hottest part of the day (Dirksen, 2014a). Older age alone is a major contributing factor to healing complications. Elderly adults' skin becomes thinner, drier, and less resilient as they are more prone to dehydration and the aging effect takes its toll on body systems (Knighton, 2014).

Full-thickness burns or third-degree burns are the burns that cause the most damage as they go through the epidermis and dermis with an extension into the subcutaneous tissue. Since the subcutaneous tissue consists of vessels, fat, nerves, and components of the lymphatic system, nerve damage is a classic manifestation of this burn (Sommer et al., 2013). Decreased nerve endings contribute to the anesthetic quality of these burns, which can look waxy white, dark brown, or charred. These burns do not have blisters but have severe edema and dry or leathery eschar, which will need to be removed. Scarring is inevitable, and healing can take anywhere from a few weeks to several months, depending on the patient. Furthermore, these burns require skin grafts due to the impossibility of re-epithelialization (Knighton, 2014). This patient's full-thickness burns appeared charred and had deep crater-like wounds filled with eschar. Due to diabetic neuropathy, this patient's back had more nerve endings and sensitization to pain stimuli than her legs. However, the burns on her back caused her very little pain, as they were deep enough to destroy nerve endings throughout much of the subcutaneous tissue.

Management and nursing care of burns is divided into these phases: emergent, acute, and rehabilitative or resuscitative, wound healing, and restorative. During each stage, a specific aspect of burn care becomes the focus. The primary goal during the emergent, or resuscitative, stage is to prevent hypovolemic shock and the formation of edema. This phase usually lasts up to

72 hours after the injury and ends when fluid mobilizes and diuresis begins. Hypovolemic shock is important to assess for and prevent as interstitial fluid increases and fluid shifts out of blood vessels into the extracellular space creating what is known as second- and third-spacing. Since fluid is moving out of the cells and vascular system, fluid replacement is a top priority. If the patient has TBSA greater than 15% and needs a large amount of fluid replacement, two large-bore intravenous (IV) access points are required. Fluid replacement formulas should be recalculated every hour based on the patient's urinary output. The type of fluid replacement used depends on the patient, but the Parkland (Baxter) formula is the most common. In patients with carbon monoxide poisoning or smoke inhalation injuries, such as this patient had, 100% humidified oxygen should be given in order to sufficiently oxygenate the peripheral tissues and prevent cardiac complications (Knighton, 2014). This patient was given the humidified oxygen shortly after she was rescued from the fire and her saturated oxygen soon improved to 85% at the scene of the incident. Also, this patient was having oliguria since she was still within the emergent phase of burn management so her fluid replacement was adjusted accordingly.

A patient with hypovolemic shock will experience a drop in blood pressure and an increase in heart rate, as can be seen with this patient. Upon admission, this patient's blood pressure was 95/40 mmHg while her heat rate was 114 bpm (Hypotension: <119 or <80 mmHg; Prehypertension: 120-139 or 80-89 mmHg; Stage I HTN: 140-159 or 90-99 mmHg; Heart Rate: 60-100 bpm; DiSabatino & Bucher, 2014). These vital signs were dangerous as this patient had insufficient peripheral tissue perfusion and a decreased cardiac output due to a high heart rate with depressed stroke volume. Signs and symptoms of thrombosis and hemolysis can appear in a patient's lab values as a high hematocrit (HCT) and high potassium level. An increased HCT means that there is an increase in blood viscosity due to hemoglobin and other blood content, which leads to sludging of the blood. Sludging of the blood puts a patient at risk for complications associated with clots and poor circulation such as venous thromboembolism (VTE). Patients with burns on the extremities should be encouraged to keep their arms or legs extended and elevated on pillows in order to reduce edema and increase circulation. Furthermore, patients should perform range of motion exercises early on in their course of care as this reduces the risk of contractures and improves one's prognosis (Knighton, 2014). This patient had her lower legs elevated on pillows and passive range of motion exercises were performed on her every few hours to improve circulation.

The increase in circulating potassium results from fluid high in electrolytes being pushed out of cells. This increase can create life-threatening cardiac issues as cells starve for potassium. Dysrhythmias are often a result of high potassium plasma levels and low potassium levels intracellularly. Abnormal lab values, such as the presence of myoglobin, are also associated with a higher risk for renal ischemia or acute tubular necrosis (ATN) as the kidneys have more blood products to filter and decreased water to help in this process. As diuresis begins at the end of this stage, a patient's urine specific gravity will be low as fluid is released in large quantities (Knighton, 2014). This patient's urine specific gravity was still within the normal range at a value of 1.015 since this patient was still in the acute phase during which fluid had not yet mobilized (Czarapata, 2014; 1.003-1.030).

Upon the initiation of diuresis, the stage of wound healing, or the acute stage, begins. This phase can last weeks to months as burned body tissue experiences the effects of the inflammatory process. During this time, it is important for nurses to monitor sodium as well as potassium intake and retention since these electrolytes are essential to the wound healing process and tend to fluctuate most with the movement of fluids. It is during this phase that superficial partial-thickness and deep partial-thickness burns begin the process of re-epithelialization, which appears pink to red and takes place from the inside out. It is at this point that the immune system response elevates in order to protect the body from infection and heal what is broken (Knighton, 2014). Soon this patient’s deep partial-thickness burns would be assessed for signs of re-epithelialization starting around the third day after the burns and the escharotomy.

Various types of WBCs, or leukocytes, are designed to play particular roles in the immune response. For example, mononuclear phagocytes include monocytes, which are present specifically in the blood, and macrophages, which are present throughout the body. These cells capture, process, and present antigens to lymphocytes, which initiates a humoral or cell-mediated immune response. B-cells are the lymphocytes that handle humoral responses as they mature into plasma cells and eventually turn into antibodies, or immunoglobulins. These immunoglobulins are specific as to what kind of responses they elicit and what kind of immunity they provide. Immunoglobulins also depend on particular cytokines, a type of chemical mediator, that are produced by helper T-cells (CD4), which primarily play a role in cell-mediated responses (Porth, 2009; Lewis, 2014a). However, in burn patients there is a decrease in immunoglobulins as well as bone marrow depression and impaired function of WBCs because of the damage to the body tissues. Therefore, the risk of infection is a lot higher for these patients (Knighton, 2014).

A typical immune response is manifested by a patient’s high white blood cell (WBC) count, or leukocytosis, which is the body’s effort to destroy an antigen or suspected pathogen. This elevation in immature WBCs, referred to as “a shift to the left,” is the cellular response of the inflammatory process initiated in the blood (Lewis, 2014b). In the vascular part of an inflammatory response, vessels first constrict and then dilate to flush out possibly harmful pathogens in the blood or send blood to the affected area for healing. This process of vasoconstriction and vasodilation causes the erythema, or redness, and edema, or swelling, that typically present with infection and inflammation (Calder et al., 2008; Lewis, 2014b). This patient had prominent erythema and edema particularly around her deep partial-thickness burns on the dorsal side of her lower extremities. Furthermore, this patient's most recent WBC level was very high at 17 k/uL, which was a solid indication that the inflammatory process was in action (Pagana & Pagana, 2013; 5-10 k/uL).

Also during the acute phase of burn management, nurses should be sure not to cool the patient's burn site longer than 10 minutes at a time and avoid immersing the affected area in an ice bath. While it is important to cool the site, ice can cause hypothermia and reduce blood supply to the wound that is needed for healing. In every phase of management for large area burns, but especially the emergent and acute, assessing the patient's airway, breathing, and circulation is of upmost importance. Any difficulty regarding one of these components can be detrimental to the patient's survival (Knighton, 2014). This patient did not require intubation or mechanical ventilation since the majority of her burns were on the lower extremities and back. However, the physician ordered an escharotomy for the patient in order to improve her circulation and prevent tissue loss in the lower extremities. Eschar, or the dead tissue build-up in a wound bed, needs to be removed because of the increased risk of infection that it brings within the burn site. Cleaning and debridement procedures help remove the necrotic tissue and allow for re-epithelialization. Once eschar is removed, fibroblasts are the cells that work to create collagen and heal the damaged tissue by forming a fibrous tissue known as a scar. This phase of healing is the granulation phase and is when the wound looks pink to red with signs of improvement in approximation (Knighton, 2014; Lewis, 2014b).

The rehabilitative stage of burn management, also referred to as the restorative phase, is when wounds heal and the patient begins engaging in his or her own care. At this point in the healing process, the patient is prepared for discharge to a rehabilitation facility or his or her own home. Often times, patients with very severe wounds require the assistance and care of another person who can help change the dressings and encourage them after such a life-altering event (Knighton, 2014; Lewis, 2014b). There are a variety of dressing choices including greasy gauze dressings, silver-impregnated dressings, and pressure dressings. Schedules for changing a dressing are made by the physician and need to take place in a room that is at least 85 degrees Fahrenheit in order to maintain the patient’s body temperature. Also during this stage of management, the prevention of contractures and other complications become a major focus as the patient tries to strengthen the skin that has already grown. Patients should be aware that the new skin never completely regains the original color and that it takes about four to six weeks for the area to solidify as a scar. Additionally, an emphasis on nutrition is necessary during this phase of nursing care since the patient will need a suitable amount of calories and protein for the body to have energy to heal properly (Knighton, 2014). This patient had not yet reached the rehabilitative stage, but was tolerating dressing changes well with moderate pain at the deep partial-thickness burn sites. However, the patient reported a reduced appetite due to occasional nausea that accompanied the pain and general fatigue that she felt since being burned.

Mature healing of the burn site can be expected anywhere from six months to two years, depending on the patient’s comorbidities and other associated risk factors. Newly healed burn sites should be kept out of direct sunlight for up to a year due to their tendency to be hypersensitive or hyposensitive to temperature and damage (Knighton, 2014). This patient appeared confused and very concerned for what was to come during the rehabilitative stage of care for she did not want to be a burden on her family or staff at her nursing home. This patient's burns will most likely take the latter end of the expected time frames for healing because of her old age and comorbidities such as type 2 DM, which complicates the healing process.

Complications and risks associated with burns are mostly dependent on the location of the burn as well as comorbidities, as previously mentioned. Compartment syndrome is what patients with burns on their extremities should be monitored for while patients with thoracic burns should be closely assessed for dyspnea or signs of respiratory distress. These complications arise as edema forms, circulation is altered, and breathing is complicated by the inability to adequately move the diaphragm for lung expansion. Besides type 2 DM, comorbidities that can lead to poor wound healing include chronic disease, such as this patient's COPD and CAD, fractures or trauma, drug abuse, and malnutrition. In addition, some risks are heightened in burn patients such as the risk for paralytic ileus and infection. To assess for and prevent these impediments, nurses should regularly auscultate for bowel sounds, promote mobility as much as tolerated, and look to drug treatment as needed to prevent any kind of infectious agent that persists despite aseptic wound care (Knighton, 2014).

Drug treatment for burn patients ranges from oral or intravenous analgesics and sedatives for pain management to antibiotics for the prevention of widespread infection. The drugs selected for treatment are specific to each patient's case and often combined with nonpharmacological interventions in order to promote comfort and healing (Knighton, 2014). This patient was prescribed intravenous morphine to manage the severe pain from her deep partial-thickness burns on the ventral side of her lower extremities. For breakthrough pain, this patient received oral oxycodone-acetaminophen (Percocet) as needed. In addition to analgesics, this patient was on oral penicillin to prevent any systemic infection that could complicate her healing since she had a higher risk for infection due to chronic comorbidities. This patient seemed to respond to dressing changes better when soft instrumental music was played in the background and appeared to have a better outlook on her situation when in the presence of family and friends.

In conclusion, burns are a result of various damaging causes with thermal sources being the most common. Burns are classified not only by their cause, but their severity that is measured by depth, location, and extent of damage. While superficial partial-thickness burns do not require hospitalization or severe treatment, deep partial-thickness burns and full-thickness burns demand more nurse-intensive care to promote optimal healing. Management of burns is divided into the emergent, acute, and rehabilitative stages, which each have different foci and goals. The inflammatory process is also part of the clinical course of a burn as the body's immune system responds to the damage and attempts to heal. Nursing care should be provided to treat symptoms, pain, and prevent infection as burn patients have a higher risk for complications surrounding infection and a diminished quality of life. Nutrition, fluid replacement, and permanent skin coverage are also very essential for nurses to hone in on when caring for burn patients. Lastly, psychological guidance and support should be given to these patients as they often struggle with life-altering changes in body image and personal care as a result of their burns. Burn patients often become very vulnerable and need the dedicated support of a nurse who provides holistic care with a goal of restoring optimal function and appearance for the patient's long-term wellbeing and healing.

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