What happened to "Primum non nocere"? Care following sepsis gone wrong

This paper explores a case study of a 95-year-old woman who presented to the emergency department with severe sepsis due to perforated diverticulosis. Sepsis is a life-threatening condition that occurs in response to an infection. When recognized and treated early, the outcome can be positive with full recovery. However, late recognition and mismanagement of the treatment of sepsis can lead to multi-organ system failure and death. There are a variety of infections that commonly induce sepsis including urinary tract infection, abscesses and even diverticulosis. The individual in this case study was managed properly with antibiotics and fluid administration to initially treat and resolve her sepsis. What happens next is unimaginable. A cascade of events occurred in the hospital including fluid overload, a pneumothorax, instrumental pneumonia, intubation with an eventual tracheostomy, cardiac arrest and resuscitation, a lacunar stroke, development of shingles, acquisition of C-difficile, an ileus, a sacral pressure sore with osteomyelitis of the sacrum and an intra-abdominal abscess that re-induced sepsis once again leading to multi-organ failure and death. Primum non nocere means "to do no harm". As nurses, we have an obligation "to do no harm" and promote recovery and health. This paper will review the sequelae of events in this case study and aim to address the following questions. How can we recognize sepsis early? Should nurses listen to family members? And, lastly, how can we prevent adverse consequences from happening during recovery from sepsis? Hopefully, by answering these questions it can be demonstrated that nurses can play an integral role in improving health care and reducing adverse events associated with sepsis.

Keywords: S*epsis, diverticulosis, intubation, iatrogenic disease, nosocomial infection*

Case Study

A relatively healthy 95-yr old women who lived independently at home under the care of her daughter underwent a bout of sepsis. Her medical directives were that all life-saving interventions be performed. She had an uncomplicated medical history including diabetes, hypertension, osteoporosis (previous hip and wrist fractures) and a bout of pyoderma gangrenosum on her shin in the previous year. She also was methicillin-resistant *Staphylococcus aureus* (MRSA) positive. Her diabetes was treated with once-a-day administration of long-acting insulin, and her hypertension was treated with daily oral intake of hydrochlorothiazide with periodic administration of furosemide. The pyoderma gangrenosum that she had during the year prior was treated with doxycycline and corticosteroids. Being positive for MRSA was not a problem at home and was not actively being treated. The patient never smoked, drank very few alcoholic beverages, maintained optimal weight and always ate a healthy and well-balanced diet. She also was regularly active in home-based recreational activities.

In early February of 2024, the patient presented with signs of sepsis (elevated temperature, tremors, projectile vomiting, loss of consciousness) at home and was rushed to the Emergency Department by ambulance. The hospital's sepsis protocol was initiated (broad spectrum intravenous [IV] antibiotics with fluid administration) and the cause of the infection was further investigated. The cause of sepsis was determined to be diverticulitis, where-by there was a slight perforation in the patient's gut wall (contributing to feacal peritonitis). Surgery was ruled out due to the patient's age and intravenous antibiotic treatment was prescribed for the diverticulitis.

The following paper describes the journey of this patient's treatment and 13-month hospital stay (11 months which were in the intensive care unit [ICU]) and the many conditions and complications acquired during her stay before she eventually passed away due to sepsis again – this time as a result of an intra-abdominal abscess that was acquired following an incident whereby a gastric tube (G-tube) was unintentionally pulled out. The paper will begin with a review of sepsis and diverticular disease, followed by an account of the patient's hospital stay. Some of the secondary complications and iatrogenic illnesses acquired will be addressed from a systemic perspective. The paper will conclude with a discussion on how nurses can be made more aware of the complications and iatrogenic illnesses that can occur following initial hospitalization for sepsis and suggest ways that these complications can be minimized.

Sepsis

Sepsis is a life-threatening condition involving an infection of the blood stream. It results from the release of endogenous inflammatory mediators (interleukin 1 [IL1], IL6, IL, IL10, tumour necrosis factor [TNF], and C-reactive protein [CRP]) in response to the infection (Matot & Sprung, 2001). The release of these mediators can systemically influence organ function leading to end-organ damage and/or failure and subsequent death. The blood-stream infection can result from numerous conditions including, but not limited to infection, pancreatitis, trauma and burns. Sepsis may present itself on a continuum as the severity of signs and symptoms increase manifesting first as systemic inflammatory response syndrome (SIRS), followed by sepsis, severe sepsis, and septic shock. The diagnosis of sepsis and its causative agent must be made as early as possible to allow for early intervention with anti-microbial therapy, fluid resuscitation and surgical drainage to reduce the risk of further progression of the disease, organ dysfunction and subsequent death. Clinical signs suggestive of sepsis include changes in mental status, body temperature changes [fever/ hypothermia], unexplained tachycardia, unexplained tachypnea, peripheral vasodilation and unexplained shock (drop in blood pressure). Blood work results indicative of possible sepsis includes leukocytosis, neutropenia, thrombocytopenia, increased cytokines and increased level of CRP.

Diverticular Disease

Diverticular disease refers to clinically significant diverticulosis (the presence of diverticula in the colon) (Feuerstein & Falchuk, 2016). Diverticula develop in the colon as a result of herniation of the mucosal and sub-mucosal layers into the circular muscular layers of the colonic walls forming a pouch, sac or pocket (Comparato et al., 2002; Feuerstein & Falchuk, 2016). This commonly occurs near the capillary blood supply. Diverticula form mostly in the distal and sigmoid colon with only a few patients developing right-sided diverticula. Diverticulitis refers to active inflammation of the diverticula.

Diverticular disease is a common disease of the colon (Feuerstein & Falchuk, 2016). During 2009, it accounted for approximately 3 million hospital outpatient visits and close to 300,000 hospitalizations in the United States. Risk factors for the development of diverticular disease include age, genetics, obesity, immunodeficiency, sex, corticosteroid use and a low fibre diet (Comparato et al., 2002; Feuerstein & Falchuk, 2016). Less than 5% of people 40 years of age or younger and more than 60 % of individuals aged 65 years and older have diverticular disease (Comparato et al., 2002). The disease appears to be more common in females than in males with majority (80-85%) of patients being asymptomatic. Many individuals are not aware that they have the condition as they do not get any symptoms. Only 15-20% will develop symptoms of diverticular disease (i.e., abdominal pain, bloating, bleeding, constipation, changes in bowel habits, etc.,). Diverticulitis is associated with perforation, infection and sepsis (Feuerstein & Falchuk, 2016). Only 5% of patients with diverticular disease develop diverticulitis (Comparato et al., 2002). The patient in our case study initially had asymptomatic diverticular disease. It was not until she presented with rectal bleeding spells prior to the onset of her sepsis, that provided some indication she could have had diverticular disease. She satisfied some of the risk factor criteria: age, female and corticosteroid use a year prior to treat her pyoderma gangrenosum.

In uncomplicated diverticulitis, patients are treated with antibiotics (oral or IV, depending upon the severity) and bowel rest. In complicated diverticulitis (which involves the formation of abscesses or a fistula or the development of peritonitis), patients are treated with IV antibiotics, bowel rest and surgical consultation. Hartmann's resection is the most common operation prescribed for patients who present with septic complications resulting from diverticular disease (Corder & Williams, 1990; Khan et al., 1995). It involves surgical removal of the diseased segment of the rectosigmoid colon, closure of the rectal stump and the creation of a colostomy. The patient in this case study had complicated diverticulitis which led to the development of sepsis. However, due to her age, surgery was not recommended, and she was permanently put on IV antibiotics.

Hospital Stay Trajectory

Hospital Stay Trajectory, Phase I

Figure 1 depicts the hospital stay trajectory for the patient in this case study, with phase 1 referring to the first, top row of the figure. Following admission to the Emergency Department, the patient was prescribed broad-spectrum IV antibiotics (Ceftriaxone and Vancomycin), fluid overload (normal saline) and blood-pressure medications (Levophed) to increase and stabilize blood pressure. Within 48 hours, the patient was transferred to the Hospital's satellite ICU (a smaller ICU located separately from the central ICU) to further stabilize blood pressure. After two days, blood pressure was stabilized, and the patient was transferred to a hospital ward floor for continued care.

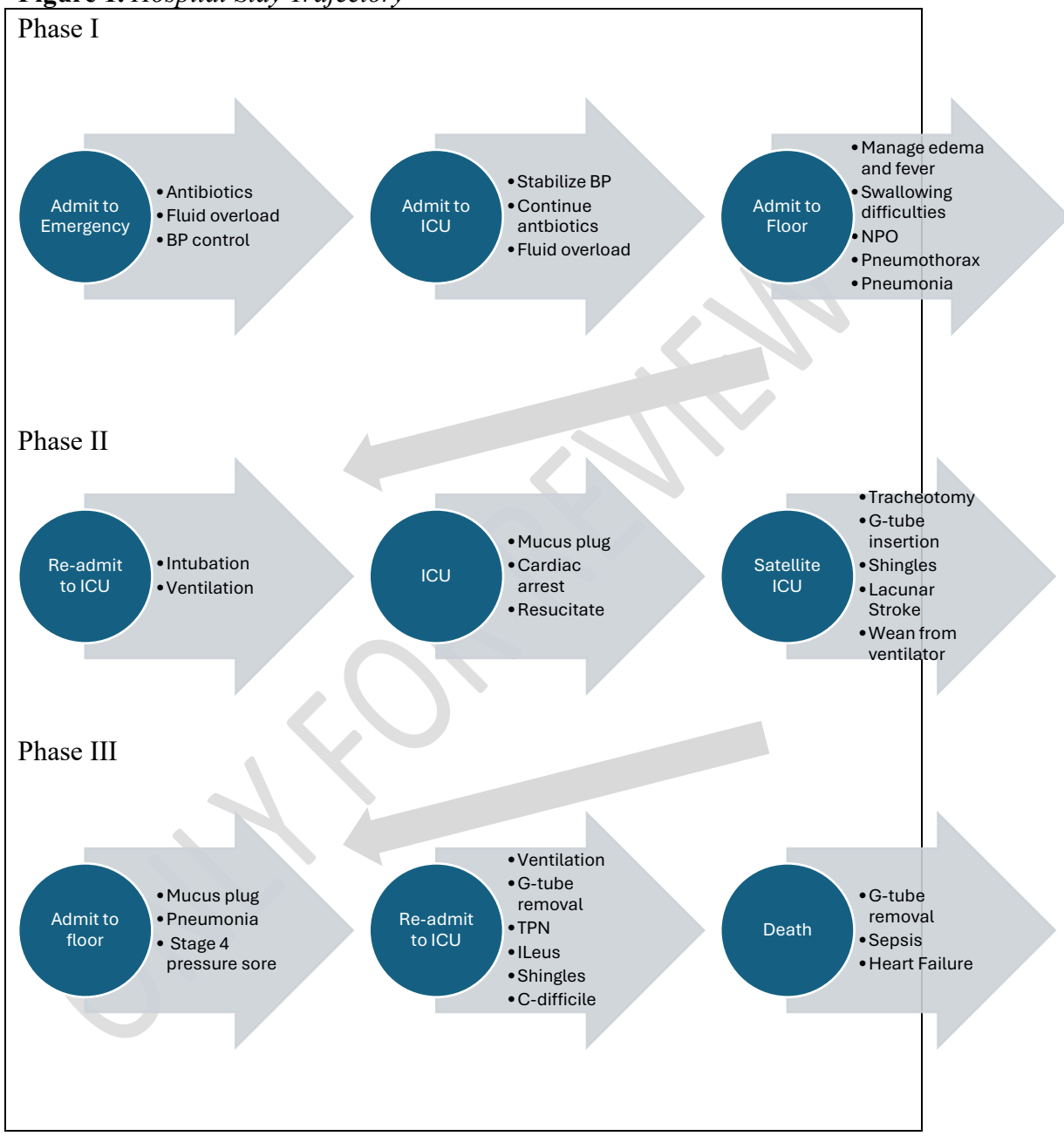
While on the floor, management of the infection and fever continued, and regaining fluid balance was pursued. The patient's legs, arms and abdomen were extremely edematous from the fluid overload in the Emergency Department. Furosemide and albumin were prescribed to achieve diuresis. Alongside of this, the patient was weak from the bout of sepsis and exhibited dysphagia (difficulty swallowing food). A family member helped feed the patient, when possible, since minimal nursing care was available to do this. At times, nursing students would attempt to help feed the patient but would normally stop when it went too slowly.

Subsequently, the patient was assessed by a speech language therapist (SLT) who determined that she had difficulty swallowing. Initially, thickened fluids were given for a couple of weeks and then subsequently "nil per os" (NPO) which is Latin for "nothing by mouth" was ordered when the risk for aspiration became too high. Thus, this edematous, diabetic patient was then on a combination of IV fluids (normal saline and 5% dextrose in water [D5W]) for over a week. The family asked for a nasogastric (NG) tube as the patient would eventually die if she did not receive any nutrients, not to mention that the fluid overload status would not resolve and her diabetes was not well-controlled.

The NG tube was ordered and put in place by an emergency room (ER) nurse. While waiting another day for the nutrition to then be ordered for the NG tube, the charge nurse came in and pulled out the NG tube saying that it was the wrong tube (it was one used to aspirate gut contents and not normally used for enteral feeds, although it could have been). What followed was thirteen more attempts (over 2 days) by various practitioners to re-insert the "proper" NG tube. The NG tube was re-inserted; however, the patient subsequently developed a pneumothorax and instrumental pneumonia in the process. The patient's pneumothorax spontaneously resolved without intervention; however, the pneumonia still ensued and was covered by the antibiotics prescribed to treat the underlying diverticulitis. The patient began to exhibit signs of breathing difficulties. Efforts to help the patient breathe with oxygen supplementation and a bilateral positive airway pressure device (BiPAP) device were unsuccessful as the patient's oxygen saturation declined, she had further difficulty breathing and

became cyanotic. She subsequently was re-admitted to the ICU for intubation and ventilation.

Figure 1. *Hospital Stay Trajectory*



Hospital Stay Trajectory, Phase II

Following placement on the ventilator, the patient's breathing status improved. However, with the pneumonia, she produced a lot of mucus. The nurses in ICU were to routinely suction mucus production as any drop in O_2 saturation (below 90 would set off alarms on the monitors). However, shortly after being admitted to the ICU, she developed a mucus plug that blocked her airway, causing her O_2 saturation to fall leading to a cardiac arrest. Being a full code, the patient was resuscitated but ended up having fractured ribs, making it difficult for her to be eventually weaned from the ventilator.

The patient was subsequently transferred to the smaller satellite ICU which had nurses nearby and more constant, closer supervision. During her time in the smaller ICU setting, she first had a thoracentesis and chest-tube placed behind her lungs to drain fluid that she had accumulated due to the fluid overload and edema which still had not resolved. After approximately two weeks, she had a tracheotomy performed and no longer required intubation. She began to speak (even though it was difficult with the tracheotomy tube in place). After approximately 2 months, she also had her NG tube replaced with a G-tube. She then had an outbreak of shingles, which was not diagnosed formerly as it was initially thought it was a heat rash (it was very hot in her room). In addition, she also was diagnosed with a very small lacunar stroke. Throughout this time, the patient was cognisant and interacted with people. During the time in the ICU, the respiratory therapists worked daily (using a variety of protocols) to wean the patient from the ventilator. Eventually, she was weaned from the ventilator and had her tracheotomy capped and could be moved from the ICU to the ward/floor.

Hospital Stay Trajectory, Phase III

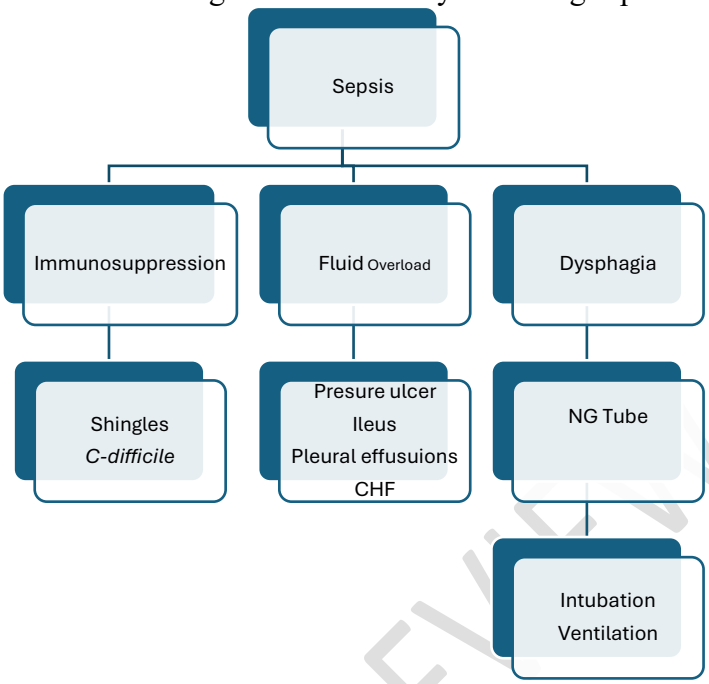
The patient's stay on the floor was very short-lived. After ~3 days, the patient developed another mucus plug that blocked one lung, pneumonia developed and was accompanied with elevated white counts. (The patient was required to have regular suctioning as required when on the floor and this did not occur leading to the pulmonary complication that ensued). The patient was hyperventilating as a result and was once again rush to the ICU and placed again on the ventilator. The next 10 months in the ICU led to a series of complications. On two occasions, her G-tube was pulled out during routine care, requiring the initiation of total parenteral nutrition (TPN). A peripherally inserted central catheter (PICC line) was inserted to provide the TPN. The PICC line was also pulled out on two separate occasions, again during basic routine patient care. The patient then continued to receive IV fluids (including D5W). Once the stomach could again receive food (the hole the gastric tube created had to close before another one was put in), gastric tube feeding was re-initiated. However, the patient presented with vomiting and it was determined that she had developed a paralytic ileus (a blockage of the small and/or large intestine) due to no food intake over a prolonged period. Fluid overload may also have contributed to the development of the ileus. Eventually this was resolved and gastric feeding resumed.

Throughout this time, clinicians were still trying to treat the edema (developed at admission) with furosemide and at times in conjunction with albumin administration. (Studies have shown that albumin administration in conjunction with diuretics increases urine output in patients with hypoalbuminemia (Kitsios et al., 2014), which this patient had). The medical professionals were briefly able to return the patient back towards her normal weight. However, the fluid overload status eventually continued indicating the presence of some chronic kidney disease (the glomerular filtration rate (GFR) remained around at ~ 60 mL/min/1.73m^2 throughout her hospital stay). Other iatrogenic conditions ensued, the development of a full thickness pressure sore to the sacrum and the acquisition of *C-difficile*. Shingles had also once again resurfaced and at this time, was properly treated with acyclovir. Throughout her hospitalization, the patient repeatedly experienced skin tears on her arms during transfers and from laying on the tubes around her. The patient's heart became weaker, and she was prescribed digoxin to treat the congestive heart failure that was developing. Once again, the patient's G-tube was pulled out during routine care. The gastric opening was subsequently covered with an ostomy bag. This led to the development of an intra-abdominal abscess, sepsis and eventual death.

Secondary Complications

Although the initial approach used to treat the sepsis induced by the bout of diverticulitis (as described above) was appropriate, the care that followed was problematic. Figure 2 provides a general summary of the care following sepsis that went wrong in this case study. The patient became further immunocompromised (diverticulitis and pneumonia continued), fluid overload and edema never resolved (placing an overload on the cardiovascular system) and the dysphagia that occurred (necessitating the insertion of the NG tube) subsequently induced complications leading to the need for mechanical ventilation. These complications are described more fully below.

Figure 2. Complications occurring in this case study following sepsis care



Legend: CHF = Congestive heart failure; NG = Nasogastric

Immunosuppression

Immunosuppression refers to impaired immune function that is associated with an increased susceptibility to common pathogens (Kreitmann et al., 2024). Increasing age as well as antibiotic use can contribute to immunosuppression. In some cases, antibiotics can also interfere with immune function in either a positive or negative way, depending upon the antibiotic prescribed (Velm et al., 1996). In this case study, the patient developed shingles (re-activation of the varicella-zoster virus) on two occasions as well as *Clostridioides difficile* (*C. difficile*) during her hospitalization. She also was prescribed antibiotic therapy due to her diverticulitis which never resolved.

Fluid Overload

Fluid overload is an unhealthy accumulation of water and electrolytes beyond that of a normal, healthy individual (O'Connor & Prowle, 2015). As part of the sepsis protocol, patients are given a bolus of fluid to maintain blood pressure and tissue perfusion. Commonly, fluid overload results as fluid resuscitation is continued over time. Most of this water accumulates in the extravascular spaces with fluid accumulation in the thorax (plural effusions) and the abdomen (ascites). This can have adverse effects on numerous systems including the brain (cerebral edema leading to impaired cognition), heart (myocardial edema with impaired contractility), lungs (pulmonary edema with impaired gas exchange and increased work of breathing), gut (edema leading to malabsorption and ileus formation) and tissue edema (leading to pressure

ulceration). This fluid overload, which was resolved only on one occasion during the patient's hospital stay may have been a contributing factor to the development of the congestive heart failure, paralytic ileus and pressure sores documented in this case study. Additional complications included increased blood pressure and pleural effusions.

Pressure Ulcer Formation

Pressure ulcers (also referred to as decubitus ulcers or bed sores) are skin injuries in localized areas (predominantly over bony protuberances) that occur as a result of prolonged direct pressure on the site (Alotaibi et al., 2024). Upon admission to the hospital, the patient in this case study had some redness present in the sacral region, indicating that the skin was damaged, but there was no skin loss (Stage I pressure sore). By the time of her death, she had developed a full thickness pressure ulcer (Stage IV pressure sore) on her sacrum of approximately 4 inches (~ 10 cm) in diameter that had led to the development of osteomyelitis. This is one area in her care which could have been minimized and possibly avoided. The patient was often left for prolonged periods of time in the supine position in her bed when she could have been moved and transferred to a chair. Nursing shortages (and lack of time) commonly did not enable the patient to be transferred to a chair, nor did it allow for regular re-positioning within the bed. Other factors that could have contributed towards the development of this pressure ulcer include poor circulation due to her diabetes, congestive heart failure as well as excess moisture due to incontinence and/or fluid overload.

Dysphagia

Dysphagia (or difficulty swallowing) is a potential complication of sepsis. A recent study reported that after treatment for sepsis, approximately 55% of patients experience dysphagia within 1-week of hospitalization with many failing to recover their swallowing function by the time of hospital discharge (Hongo et al., 2023). Reasons behind the development of dysphagia following sepsis care can be attributed to ICU acquired weakness (ICU-AW), fasting, tube-feeding as well post-exudation dysphagia.

The patient in this case study was initially in the ICU for a short period of time (2 days in the emergency room plus ~ 2 days in the ICU). Thus, fasting status and ICU-AW may have also contributed to the development of dysphagia for this patient. Complications associated with dysphagia include aspiration, aspiration-induced pneumonia, reduced quality of life, delayed resumption of oral intake and prolonged hospital stay (Zuercher et al., 2019). Potential therapeutic approaches have been suggested by Zuercher et al., (2019) which includes screening for dysphagia in the ICU, modification of dietary textures (i.e., prescribing thickened fluids), compensatory manoeuvres including postural changes and interventional measures to improve swallowing such as pharyngeal electrical stimulation.

Other issues and complications subsequently were related to the feeding procedures and practices. As described above, due to swallowing difficulties; the

speech language therapist eventually ordered NPO. Following a week of only D5W and normal saline IV administration, the patient was ordered an NG tube for feedings. The first complication was associated with the placement of the NG tube. Improper insertion of an NG tube into the trachea, bronchi or lungs has been reported to occur in only 0.2 to 0.3 % of patients (Gupta et al., 2014). This complication can induce several pulmonary sequelae including pneumonia, pulmonary laceration, pulmonary contusion or pneumothorax. As described in the case study presentation, it took thirteen attempts to put in a NG tube. However, the patient developed a pneumothorax and instrumental pneumonia in the process (on top of what might have also been pre-existing aspiration pneumonia). This led to respiratory complications, the initial need for the use of a BiPAP device and then intubation and ventilation in the ICU.

Percutaneous endoscopic gastrostomy (PEG) tube insertion is indicated in patients who have a normal functioning gastrointestinal tract, but who require long term (> 30 days) nutritional support (Blumenstein et al., 2014). The patient in this case study had a PEG tube inserted. Problems occurred with the G-tube, whereby it came out on two occasions. In the first instance it was a factor that led to the development of a paralytic ileus due to lack of enteral nutrition (limiting movement of the gut over a prolonged period) (Madi & Druml, 2003) and in the second instance, the development of an intra-abdominal abscess at the PEG tube site which subsequently led to the patient's death. Peristomal wound infections are common in patients with PEG tubes, with infection rates ranging from 4 – 30% (Blumenstein et al., 2014). Some infections are minimized with proper skin and stomal care as well as proper bandaging techniques, whereas others require antibiotics. Extra attention is also required in patients with methicillin-resistant Staphylococcus aureus (MRSA) (as in this case) as it has been reported to be a cause of PEG-related wound infections.

Intubation/ventilation

Endotracheal intubation, although life-saving, can also induce a variety of complications (including, but not limited to, damage to the oropharynx, larynx, trachea and lungs; the development of pneumonia and mucus plug formation) (Li et al., 2016). A review of the literature did not reflect a high incidence of cardiac arrests in ventilated patients. Most of the literature described cases of cardiac arrest before ventilation is begun. There is one case report in the literature of a 79-year-old male on ventilation, following complications of a Whipple procedure, which describes his cardiac arrest occurring due to a blood clot formation in the endotracheal tube (Li et al., 2016). In this case report, the patient's oxygen saturation initially dropped to 69% when respiratory therapy was called. Resistance in the airway was high, and the patient could not be ventilated or oxygenated. His heart rate dropped to the 20's and blood pressure fell to 50/30, following which resuscitation ensued for a "pulseless electrical activity" cardiac arrest. For the case study in this paper, cardiac arrest was attributed to a mucus plug formation, most likely within the endotracheal tube as a similar scenario ensued. Li et al., (2016) has proposed an intubation bundle

protocol for quality improvement and patient safety within the ICU so that these types of complications do not occur.

Conclusions: Nursing Implications

This case study presented an interesting sequalae of events related to diverticulitis-induced sepsis. Some of the events that occurred during this patient's hospital trajectory could have been prevented or minimized and consultation with (and listening to) family members could have facilitated care. Below, the following questions are answered. How can we recognize sepsis early? Should nurses listen to family members? And, lastly, how can we prevent adverse consequences from happening during recovery from sepsis?

Early Recognition of Sepsis

Due to the life-threatening risk associated with sepsis, it is important to recognize sepsis early. Some of the subtle signs that this patient exhibited for a couple of days before going to the hospital were: difficulty to arouse from sleep and a withdrawn/ quiet presence (behaviour that was not normal for the patient). Being aware of early changes in a person's behaviour should be an indication that something may be wrong, especially in the elderly. In this case study, it was not until the presentation of chills, increasing body temperature (fever) and projectile vomiting that indicated possible sepsis and the need for urgent medical care.

The Role of Family Members

Close family members know the patient well and can be a wonderful resource as to the patient's previous health status. In this case study, the family repeatedly indicated their concern for the fluid overload status, swallowing difficulties and the need for nutrition management (e.g., NG tube). However, the extent of fluid overload was negated and the patient continued to become edematous. Early and effective fluid management could have reduced some of the consequences that occurred (e.g., pleural effusion and congestive heart failure). The dysphagia was eventually recognized, and steps were taken to rectify that. However, increasing awareness among nursing staff that dysphagia is a complication following sepsis, may have improved the outcome.

Minimizing Adverse Consequences

Since nursing interventions are instrumental in preventing and managing pressure ulcers, nurses should have up-to-date education about the risk factors (i.e., age, immobility, prolonged hospitalization, nutritional status, fluid overload) associated with the development of pressure ulcers (Alotaibi et al., 2024). Nurses should be able to develop a care plan that is appropriate for each individual patient that will reduce the incidence of the formation of pressure ulcers during

a patient's hospital stay. Strategies that can be implemented include regular skin assessment at sites vulnerable to the development of pressure ulcers (i.e., sacrum, heels, elbows, scapula), proper skin hygiene, moisture assessment, regular repositioning and enhancing mobility. Continuity in care (by the same nurse) for prolonged hospital stays would also be helpful. It would enable nurses to recognize when a pressure sore is developing and to take measures to stop the skin breakdown that subsequently occurs with the development of pressure ulcers.

Finally, in the literature, it has been reported that between 3 to 14% of in-hospital complications can be attributed to the use of medical instruments and tubes such as the endotracheal tube (ETT), NG and G-tubes, indwelling catheters and intravascular lines (Gupta et al., 2014). Knowing this, many of the complications with the ETT, NG tube, G-tube and PICC lines that developed with this patient could have been prevented. In this case, the ETT accumulated a mucus plug; there was difficulty with inserting the NG tube; the G-tube and PICC lines were pulled out during routine care.

Constance vigilance for persons on ventilators is imperative to prevent life-threatening complications as seen in this case study. Furthermore, extra attention should be made when providing routine daily care so that tubes do not get unintentionally pulled out and that skin tears do not occur. Regular turning and repositioning should be done to minimize the development of pressure sores. Afterall, the nurse has a responsibility "to do no harm" (*primum non nocere*) and can do this by practicing diligence – especially for patients in the ICU.

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