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Case Study #2 Paper
Septic Shock on Pressor Support

Introduction

Septic shock occurs when infectious agents in the bloodstream produce hemodynamic decompensation. Its pathogenesis involves a series of complex stages including sepsis, severe sepsis, and septic shock. The initial priority in the management of septic shock is to maintain a reasonable mean arterial pressure (MAP) and cardiac output while the infection is identified and treated accordingly.[1] Septic shock can cause multiple organ failure, which can potentially lead to death. The mortality rate of patients inflicted by septic shock is approximately 50%.[1,2] Its most common victims include children, immunocompromised individuals, and the elderly.[2] Sepsis management requires a multidisciplinary team including physicians, nurses, pharmacy, respiratory, dietitians, and administration to maximize the chance for success. The purpose of this case study is to analyze the disease background of septic shock and apply this knowledge to the *nutrition* assessment and intervention of a patient.

Patient Profile

The patient, Ms. A, is a 62 year old Caucasian female who was admitted on January 27, 2015 and underwent withdraw of care on February 12, 2015. Ms. A was single, non-religious, and lived most of her life in a state hospital. Therefore, she was unemployed and her level of education is unknown. She had one known family member, her sister, who reportedly visited once during her hospital stay and provided no vital information.

Ms. A was diagnosed with adolescence-onset paranoid schizophrenia and bipolar disorder at the age of 20 years. Her mentation was severely afflicted by the diagnosis of schizophrenia along with an altered mental status. Therefore, all personal information was

obtained from her most recent boarding home director resulting in some unknown details regarding her background. Other past medical history includes coronary artery disease, congestive heart failure, hypertension, hypothyroidism, diabetes mellitus type 2, and chronic kidney disease. She was reportedly a longtime smoker and consumed a regular diet. Accordingly to the boarding home director the patient was "difficult to manage, must be watched very closely, poor boundaries, continuously tried to escape, will eat out trash cans, very aggressive at times, not suicidal, however quite paranoid". Her outpatient medications included Lisinopril, Klonopin, Trazadone, and Synthroid. The dosage and frequency of her medications are unknown. See table 1 for medication descriptions.

Table 1. Outpatient Medications

Medication	**Drug Class**	**Used to Treat**
Lisinopril	ACE inhibitor	HTN, CHF, MI
Klonopin	Psychotropic	Seizures, panic attacks
Trazadone	Psychotropic	Depression, anxiety
Synthroid	Hormone Replacer	Hypothyroidism

The patient was admitted with chief complaints of generalized weakness and malaise from her boarding home. Upon admission in the ER, she was found to be hypotensive with a blood pressure of 86/40 mm Hg and sinus bradycardia (<60 beats/minute at rest).

Disease Background

As previously stated, sepsis is a three-stage syndrome starting with sepsis and progressing to severe sepsis to septic shock. The defining criteria for the stages of sepsis are stated in the most up-to-date *Surviving Sepsis Campaign: International Guidelines for*

Management of Severe Sepsis and Septic Shock of 2012.[3] The definition of sepsis is the presence of infection associated with a systemic inflammatory response that results in physiologic alterations at the capillary endothelial level. Sepsis can be caused by any type of infection-bacterial, fungal, or viral. The most common causes of sepsis are pneumonia, kidney infection, abdominal infection, and bacteremia.[2] Pneumonia is the most common cause, accounting for almost half of all cases, followed by intra-abdominal and urinary tract infections.[4] To be diagnosed with sepsis, the patient must test positive for infection and exhibit at least two of the following symptoms:[3]

- Fever (>101.3°F)
- Hypothermia (<96.8°F)
- Heart rate > 90 beats per minute
- Tachypnea (rapid breathing)
- Altered mental status
- Edema
- Hyperglycemia
- Inflammatory variables
    - Leukocytosis
    - Leukopenia
    - Immature white blood cells
    - Elevated C-reactive protein (CRP)
    - Elevated prolacitonin (PCT)
- Hemodynamic variables
    - Hypotension (Systolic blood pressure < 90mm Hg, MAP < 70mm Hg, or an SBP decrease > 40mm Hg in adults or less than two standard deviations below normal for age)
- Organ dysfunction variables
    - Hypoxemia (low oxygen in the blood)
    - Acute oliguria (urine output <0.5 mL/kg/hr for at least 2 hours despite fluid replacement)
    - Creatinine increase >0.5mg/dL
    - Ileus (absent bowel sounds)
    - Thrombocytopenia (platelet count <100,000)
    - Hyperbilirubiemia

- Tissue-perfusion variables
    - Hyperlactatemia
    - Decreased capillary refill or mottling (uneven yellowish spots on the skin)

Severe sepsis is defined by sepsis complicated by tissue hypoperfusion (inadequate supply of blood to an organ or extremity) or acute organ dysfunction. Acute organ dysfunction is primarily caused by inflammation, which causes small blood clots to form thereby blocking oxygen to vital organs. The diagnosis will be upgraded to severe sepsis if the patient exhibits at least one of the following symptoms, which indicate an organ may be failing:[3]

- Sepsis-induced hypotension
- Elevated lactate (>0.5-1 mmol/L)
- Low urine output (<0.5mL/kg/hr for >2hrs despite fluid replacement)
- Acute lung injury
- Creatinine >2.0 mg/dL
- Bilirubin >2 mg/dL
- Platelet Count <100,000
- Coagulopathy (international normalized ratio >1.5)

Septic shock is defined by severe sepsis complicated by either hypotension that is resistant to fluid resuscitation or by hyperlactatemia. The symptoms associated with septic shock include: [2,3]

- Any symptom of severe sepsis
- Severe hypotension
- Altered mental status
- Diarrhea
- Nausea and vomiting
- Cold, clammy, pale skin

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The incidence of sepsis appear to be increasing in the United States possibly due to the aging population, drug-resistant bacteria, and weakened immune systems. Currently, most sepsis episodes are observed in patients older than 65 years.[2] Approximately half of all patients who succumb to septic shock die from multiple organ failure. For survivors, an episode of severe sepsis puts the patient at a higher risk for future infection.[1,2] The risk factors for developing sepsis include:[2]

- Age
    - Infants
    - Elderly (>65 years old)
- Compromised immune system
    - HIV
    - Cancer treatment
    - Transplant drugs
- Preexisting illness, wounds or injuries
- Presence of invasive devices
    - Intravenous catheter
    - Intubation

In order to diagnose the etiology and type of infection laboratory tests can be administered and/or imaging scans of vital organs. The laboratory tests can include blood tests for the source of infection, clotting dysfunction, abnormal renal or hepatic function, impaired oxygen availability, and electrolyte imbalances; urine test for presence of a urinary tract infection or signs of bacteria; wound secretions (if present); and respiratory secretions (if sputum is present). The imaging scans include x-rays, CT sans, ultrasounds and/or MRI.[2]

According to the Surviving Sepsis Campaign, routine screening of potentially infected seriously ill patients is recommended to prevent severe sepsis and allow early implementation of sepsis therapy to decrease sepsis-related mortality. See table 2 for the

outline of steps to be taken upon admission to the Intensive Care Unit (ICU) for surviving sepsis.[3]

Table 2. Surviving Sepsis Campaign Care Bundle.[3]

To be completed within 3 hours	1) Measure lactate levels 2) Obtain blood cultures prior to administration of antibiotics 3) Administer broad spectrum antibiotics 4) Administer 30 ml/kg fluid for hypotension or lactate >4mmol/L
To be completed within 6 hours	5) Apply vasopressors for hypotension that does not respond to initial fluid resuscitation to maintain MAP≥65mmHg 6) If septic shock ensues or initial lactate >4mmol/L, measure central venous pressure and oxygen saturation 7) Re-measure lactate if initial lactate was elevated.

During the first six hours of resuscitation, the goals of initial resuscitation of sepsis-induced hypoperfusion should include all of the following as a part of the treatment protocol:[3]

a. Central venous pressure (CVP) 8-12 mm Hg
b. MAP ≥ 65 mm Hg
c. Urine output ≥ 0.5 mL/kg/hr
d. Superior vena cava oxygen saturation or mixed oxygen saturation 70% or 65%, respectively

After cultures have been obtained and a diagnosis of infection(s) has been established along with the according antimicrobial therapy, fluid therapy of 30mL/kg of crystalloids (salt-containing fluids) is vital. If the patient requires substantial amounts of crystalloids, the use of albumin is recommended.[3]

If hypotension ensues despite fluid resuscitation, vasopressors therapy, also called pressor support or catecholamines, is recommended to raise reduced blood pressure. The

initial target for vasopressor therapy is a mean arterial pressure (MAP) of 65 mm Hg. If the MAP falls below the threshold, auto-regulation of vascular beds can be lost resulting in organ failure and ischemia. According to the Surviving Sepsis Campaign, norepinephrine is recommended as the first-choice vasopressor. Epinephrine can be added to or substituted for norepinephrine when an additional agent is needed to maintain adequate blood pressure. Vasopressin (up to 0.03 U/min) can be added to norepinephrine with the intent raising MAP to target or decreasing norepinephrine dosage. Low dose vasopressin is not recommended as the single initial vasopressor for treatment and vasopressin doses higher than 0.03-0.04 U/min should be reserved for salvage therapy (failure to achieve an adequate MAP with other vasopressors). Dopamine is suggested as an alternative vasopressor agent to norepinephrine only in patients with low risk of tachycardia. Phenylephrine is not recommended in the treatment of septic shock unless norepinephrine is associated with serious arrhythmias, cardiac output is high and blood pressure is low, or as salvage therapy when combined with vasopressor agents have failed to achieve the MAP target.[3] See table 3 for complete listing of vasoactive agents, associated receptors, dosages, usages, target effect, and GI complications.

Inotropic agents are compounds used to increase cardiac contractility. Some drugs have dual vasopressor and isotropic effects. Dobutamine is the first choice inotrope for patients with low cardiac output in the presence of adequate left ventricular filling pressure and adequate MAP. A trial of dobutamine infusion of up to 20 mcg/kg/min may be administered or added to a vasopressor in the presence of a myocardial dysfunction or ongoing signs of hypoperfusion.[3]

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The use of corticosteroids is not suggested as treatment for adult septic shock if adequate fluid resuscitation and vasopressor therapy are able to restore hemodynamic stability. If this effect is not achievable, intravenous hydrocortisone alone at a dose of 200mg per day is suggested.[3]

Table 3. Vasoactive agents.[1,5]

Drug	Receptor	Typical Dosing *mcg/kg/min*	Pathophysiology	Clinical Uses	GI Effects
Epinephrine	α β1 β2	Dose: 0.05 - 0.5 Max: 1	Arterial vasoconstriction, contracts heart, peripheral vasodilation	Shock, cardiac arrest, anaphylaxis, heart block, bradycardia	↓ Splanchnic blood flow
Norepinephrine (Levophed)	α* β1	Dose: 0.05 - 1.5 Max: 3	Arterial vasoconstriction, contract heart	Septic shock	↑ Gastric pH, ↑ splanchnic blood flow, ↓mucosal blood flow
Dopamine	Dopa- α β1	Dose: 5 – 20 Max: 50	Vasodilation in renal & mesenteric beds, arterial vasoconstriction, contracts heart	Septic shock, bradycardia	↓ pH, ↑oxygen delivery, precapillary vasoconstriction, ↓mucosal blood flow
Phenylephrine	α	Dose: 0.4 – 9.1	Arterial vasoconstriction	Septic shock, hypotension	
Dobutamine	β1	Dose: 2.5 Max: 40	Contracts heart	Heart failure	↓GI mucosal blood flow, ↑gastric intramucosal pH
Vasopressin (ADH)	V1	Dose: 0.01 – 0.04 *U/min*	Constricts vascular smooth muscle & increases uptake of catecholamines	Hypotension, septic shock, GI bleed, esophageal varices, diabetes insipidus, ↓ pressor needs	↑Intestinal vasoconstriction

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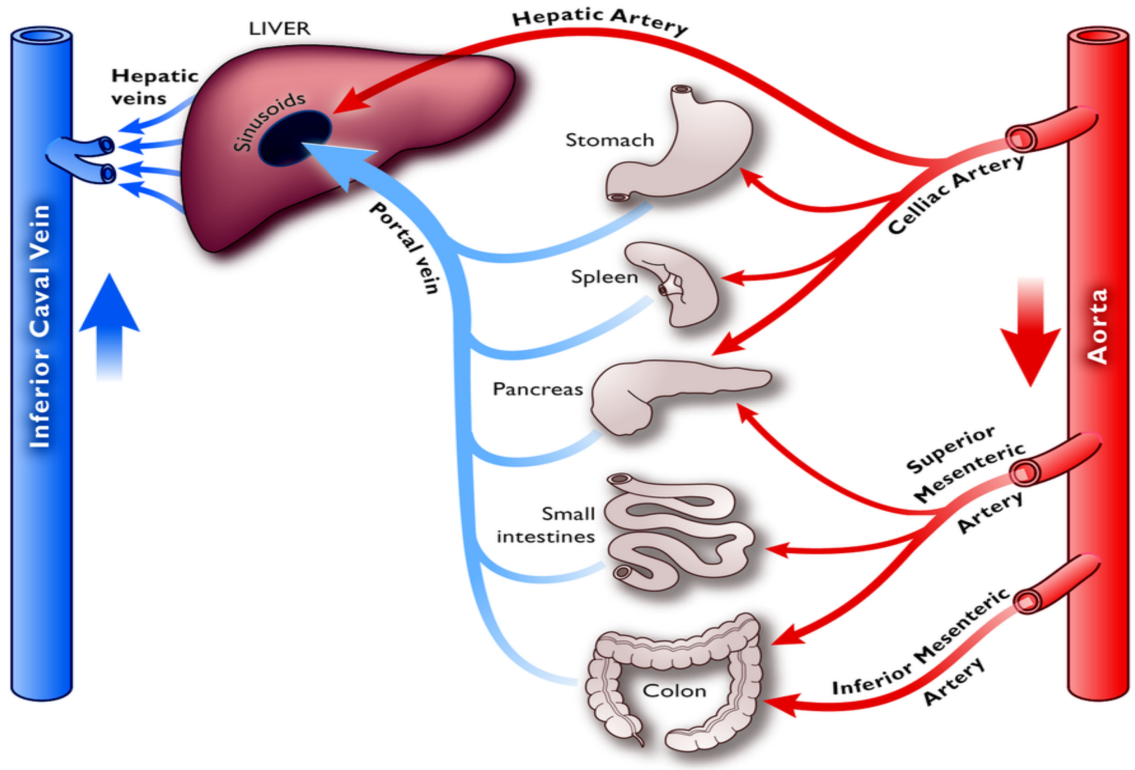
The splanchnic system receives nearly 25% of the cardiac output through three large arteries: the celiac artery (which has three major branches: hepatic, splenic, and gastric), and the superior and inferior mesenteric arteries (See figure 1). Vasopressors can cause splanchnic arterial constriction or relaxation. The net effect depends on the specific vasopressor involved, their concentrations at adrenergic receptors, and the densities of the adrenoceptor subtypes within the vasculature. The major effect of vasopressors on splanchnic circulation is vasoconstriction, which increases blood pressure.[6]

Figure 1. Splanchnic circulation.[6]



In hemodynamically unstable patients, enteral nutrition (EN) will increase splanchnic oxygen demand, rather than increase cardiac output. If the body is not able to meet this demand, splanchnic ischemia ensues. Further complications include small bowel necrosis characterized by abdominal pain, distention, high nasogastric (NG) output, ileus,

and possibly mortality. The American Society for Parenteral and Enteral Nutrition (ASPEN) and the Society of Critical Care Medicine (SCCM) suggest withholding EN in hemodynamically unstable patients on high-dose pressor support until stable, while advocating for the cautious use of EN in patients on low-dose pressor support.[5]

Application to Patient

Ms. A's initial diagnoses were septic shock secondary to urinary tract infection (UTI), hypotension, and acute renal failure via urinalysis and blood testing. Further testing showed sinus bradycardia, cardiomegaly, vascular congestion, atelectasis versus infiltrate in the right lung via x-ray, hypothyroidism, and elevated troponins. She was started on rocephine antibiotic for the UTI. She was also started on normal saline (NS) at 100 ml/hour and started on 2 liters on nasal cannula for possible pneumonia. Her anticipated plan of care was to contact any possible family for past medical history, contact speech for swallow study, repeat chest x-ray, repeat troponin checks, blood pressure monitoring, and physical therapist assessment.

On the day of her admission, Ms. A was given a burger for dinner upon her continuous demand and choked. She was then made NPO. At 2:20am, Ms. A vomited, aspirated, and developed bradycardia and went asystolic for nine minutes. CPR was started and epinephrine was administered. Then she received two counter-shocks and was given a bolus of amiodarone, to which she returned to a perfusing (normal) heart rhythm and given atropine. A central line was placed to administer continuous pressor therapy of dopamine (2 mcg/kg/min) and propofol for sedation. Lastly, Ms. A was intubated and placed on a ventilator for respiratory support.

Her assessment per the MD included:

1) Status post cardiac arrest, most likely due to her aspiration and subsequent asystole
2) Respiratory failure secondary to aspiration
3) Septic shock, on pressor support
4) Positive troponin, most likely secondary to the arrest; possible acute coronary syndrome
5) History of schizophrenia

Her plan of care per the MD included:

1) Adjust ventilator while increasing the rate and the tidal volume to help with her respiratory acidosis.
2) Discontinue propofol and reassess neuro-status. If necessary, addition of fentanyl for sedation.
3) Continue antibiotics
4) Wean dopamine off to keep MAP greater than 65. Once her MAP is > 65 and dopamine is off, we will wean her Levophed (epinephrine).

Nutrition Care Plan

Nutrition Assessment, Diagnosis, Intervention, Monitoring & Outcomes

The patient's anthropometrics include:

- Height: 5'10 (70 in)
- Weight: 268 lb (122 kg)
- IBW: 150 lb (68 kg)
- % IBW: 180
- Adjusted body weight (ABW): 180 lb (82 kg)
- Body mass index (BMI): 38.4
- BMI Class: Obese

Ms. A received four total dietetic visits including her initial assessment, and three follow-ups visits. I personally assessed Ms. A three out of the four assessments due to relief of my clinical staff rotation.

Initial Visit on 1/30:

Assessment*:* Status post cardiac arrest, septic shock secondary to pneumonia-on low pressors, tapering off, ARF, Acute Respiratory failure secondary to aspiration pneumonia-on vent support, and severe schizophrenia-on mild sedation.

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Current Diet/Appetite: NPO; OGT for suction-discontinuing soon and placing dobhoff tube.
Hydration*:* NS @ 50 ml/hour; generalized edema 2+/3+
Estimated needs on Vent Support*:* 2112 kcals (Penn st), 82-98g protein (1-1.2g/kg ABW), 2050 ml fluid (25 ml/kg ABW)
Regimen provides: 1200 ml fluid
Nutrition Status*:* Severe
PES statement*:* Inadequate energy intake related to respiratory failure as evidence by NPO and vent support.
Recommendation*:* Nepro at goal rate 50 ml/hour- Initiate at 30 ml/hour & titrate as tolerated. Regimen will provide 2160 kcals, 97g protein, and 870 ml. When IVF discontinue flush 200ml q 4hrs (2070ml total). If K+ <4.5, will switch to less concentrated formula.
Outcomes*:* Patient to meet >75% of ENN within 24-48 hours, maintain LBM, promote gradual weight loss toward IBW.
Follow-up: 5 days

Initial Visit Labs and Medications:

Sig. labs	1/30
Glucose	134 (H)
BUN	29 (H)
Na^{+2}	134 (L)
K+	6.1 & 5.2 (HH, 1/29); 4.9 (1/30)
CO_2	20 (L)
Ca^{+2}	8 (L)
Albumin	1.9 (L)
GFR	49 (L)
Mag	2.0
Lactate	2.4 (H)
TSH	5.56 (H)

Significant Meds	Usage	Dosage
Norepi-nephrine	Pressor	.02 mcg/kg/min
Fentanyl	Narcotic	5 mcg/kg/hr
Klonopin Lorazepam Trazodone	Panic disorders	1mg 2mg 100mg
Colace Senna	Laxative	100mg 34.4mg
Pepcid	Reflux	20mg
Arixtra	Anti-thrombotic	2.5mg
Lasix	Diuretic	40mg
Zosyn	Antibiotic	2.25g

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Visit #2 on 2/4:

Assessment F/U. Patient extubated-on Cipap, off pressors, not following commands but able to communicate somewhat, yells out, restrained. Last bowel movement 2/3
Current Diet/Appetite: Continues on Nepro @ 50 ml/hour (goal rate). RN gave trial sips of water today-patient tolerated.
Hydration: NS @ 50; generalized edema 2+
Estimated needs*:* 1850-2100 kcals (23-26 kcals/kg ABW), 82-98g protein (1-1.2g/kg ABW), 2050 ml fluid (25 ml/kg ABW)
Regimen provides: 2160 kcals, 97g protein, 2070 ml (870ml TF, 1200ml IVF)
Nutrition Status*:* Severe
PES statement*:* Inadequate PO food intake related to swallowing difficulty & confused/disoriented as evidence by enteral support.
Recommendation*:* Continuing current TF regimen of Nepro @ 50 ml/hour due to elevated phosphorus. Recommend swallow evaluation when appropriate.
Outcomes*:* Patient to continue meeting >75% of ENN from EN, maintain LBM, promote gradual weight loss toward IBW.
Follow-up: 5 days

Initial Visit Labs and Medications:

Sig. labs	2/4
Glucose	175 (H)
K+	4
Phos	4.8 (H)
Albumin	1.8 (L)
Mag	1.5 (L)
WBC	11.4 (H)

Significant Meds	Usage	Dosage
Klonopin Trazodone Trileptal Valporic acid	Panic disorders	0.5mg 50mg 300mg 500mg
Ambien	Sedative	5mg
Pepcid	Reflux	20mg
Arixtra	Anti-thrombotic	2.5mg
Lasix	Diuretic	40mg
Zosyn	Antibiotic	4.5g
Mag Sulf 1%	Mag replacement	2g

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Visit #3 on 2/6:

Assessment F/U- On Bipap, restrained due to aggressive behavior overnight. 10-day zosyn discontinuing today for aspiration pneumonia. DNR.
Current Diet/Appetite: TF changed per MD to Glucerna 1.0 @ 50 (2/5). No consult sent. Patient tolerating TF with no residuals. Last bowel movement 2/6. R heel intact blister & R sole skin tear.
Hydration: NS @ 50; generalized edema 2+
Estimated needs: 1850-2100 kcals (23-26 kcals/kg ABW), 120-125g protein (1.5g/kg ABW), 2050 ml fluid (25 ml/kg ABW)
Regimen provides: 1200 kcals, 50g protein, 2224 ml (1024 ml TF, 1200ml IVF)
Nutrition Status: Severe
PES statement: Inadequate EN nutrition related to current regimen as evidence by estimated energy needs
Recommendation: Glucerna 1.2 @ goal rate of 70 ml/hour + 1 pack Prostat daily to provide 2116 kcals, 116g pro, 1352 ml. When IVF d/c, flush 175ml q 6hrs (2050ml total). Recommend ordering PAB with AM labs.
Outcomes: Patient to continue meeting >75% of ENN from EN, maintain LBM, promote gradual weight loss toward IBW.
Follow-up: 5 days

Initial Visit Labs and Medications:

Sig. labs	2/6
Glucose	93, 138, 133, 115, 123, 161, 110, 169
K+	4.1
Phos	3.3
Albumin	1.8 (L)
CO2	39 (H)
WBC	11.4 (H)

Significant Meds	Usage	Dosage
Klonopin Trileptal Valporic acid Geodon	Panic disorders	0.5mg 300mg 500mg 10mg
Colace	Laxative	100mg
Pepcid	Reflux	20mg
Arixtra	Anti-thrombotic	2.5mg
Lasix	Diuretic	20mg
Mag sulf 1%	Mag replacement	1g
Zosyn	Antibiotic	4.5g

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Visit #4 on 2/11 & Endpoint:

Ms. A passed her modified barium swallow study and was moved to a general floor. She was advanced to a regular diet with 70% intake. However, the following day Ms. A passed away with the official cause of death being septic shock, acute hypercapnic respiratory failure, and atelectasis.

Conclusion

In summary, Ms. A came in with septic shock with, what appeared to be, acute organ failure, particularly that of the lungs. Her power of attorney, her sister, deemed her a do not resuscitate (DNR) patient. From a nutrition standpoint, she progressed well from enteral nutrition support to tolerance of a regular diet. However, from a medical standpoint, she had a poor prognosis. By the time she had reached the hospital, full septic shock had ensued and the MDs followed the recommended protocol.

Rest in peace Ms. A.

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