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Effect of Body Habitus on Mortality Risk in Septic Patients

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PERMISSION

Title: Effects of Body Habitus on Mortality Risk in Septic Patients

Department: Nursing

Degree: Master of Science

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Abstract

This literature review was executed after successful completion of an Objective Structure Clinical Examination (OSCE) and oral defense. The following case report was analyzed and the topic of mortality risk in septic patients who have an obese vs. normal body habitus was formulated. Research was completed using CINAHL Complete and PubMed databases. Keywords used included “obese,” “sepsis,” and “mortality.” Publication dates between 2015 to 2020 with limitations set to the English language and full-text articles were added. Data and recommendations from the Centers for Disease Control and Prevention (CDC), the Sepsis Alliance Organization, and the World Health Organization (WHO) were also reviewed.

While the literature and data in these articles address the high rate of mortality associated with sepsis, it is important to consider factors that may heighten or hinder survival. In recent years, body habitus has been researched as a topic of interest in the treatment and mortality rate of septic patients. By understanding the correlation between body habitus in septic patients and mortality rate, therapeutic strategies and patient prognoses can be improved.

Effect of Body Habitus on Mortality Risk in Septic Patients

Background

Sepsis or septicemia is defined as the presence of microbial toxins (bacteria, viruses, fungi, or parasites) in the blood. How the microbial toxins enter the body and determine the site of infectious disease is dependent on the type of pathogen, the portal of entry, and the competence of the host's immunologic defense system (Grossman & Porth, 2014). Sepsis is the result of an already present infection, in the skin, lungs, urinary tract, etc., triggering a chain reaction and extreme response throughout the body where the immune systems ultimately stops fighting the "invaders" (CDC, 2019; Sepsis Alliance, 2020). Sepsis is considered a life-threatening medical emergency, and if it is not recognized and treated promptly, it can progress to tissue damage, organ failure, and death (CDC, 2019; Sepsis Alliance, 2020). Each year, at least 1.7 million adults in America develop sepsis and nearly 270,000 of these American die (CDC, 2019).

There are many predisposing factors that are considered higher risk for adults and are known to increase the incidence of sepsis. These risk factors include being over the age of 65, having a chronic medical condition (diabetes, lung disease, cancer, and kidney disease), and having a weakened immune system (CDC, 2019; Sepsis Alliance, 2020). A patient with sepsis may present with a high heart rate, confusion or disorientation, extreme pain or discomfort, fever, shivering, or feeling very cold, shortness of breath, and/or clammy or sweaty skin (CDC, 2020). Sepsis progresses to severe sepsis when organ dysfunction is present. Symptoms of severe sepsis may include difficulty breathing, low or no urine output, changes in mental status, etc. Septic shock is the most severe level of sepsis and is diagnosed when a patient becomes dangerously hypotensive (Sepsis Alliance, 2020). Sepsis is unfortunately often acquired in the

health care setting and these infections are often resistant to antibiotics and can quickly lead to deterioration of health (WHO, 2020). According to the CDC (2019), “1 in 3 patients who die in a hospital have sepsis” (p. 1).

Body mass index (BMI) is calculated by taking a person’s weight in kilograms and dividing it by their height in meters squared. BMI measurements are used as an inexpensive and easy method of screening for weight category. BMI does not measure body fat directly, but has been found to be strongly correlated with various metabolic and disease outcomes (CDC, 2017). The following table with standard weight categories is from the CDC (2017) and is applied to adults over the age of 20 for both the male and female genders.

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal or Healthy Weight
25.0 – 29.9	Overweight
30.0 and Above	Obese

It is well known that people who are obese are at increased risk for many diseases and health conditions including, but not limited to, hypertension, dyslipidemia, type II diabetes, stroke, osteoarthritis, some cancers, and mental illness (CDC, 2017). In the United States, 71.6% of adults over the age of 20 are overweight and 39.8% of the overweight population is categorized as obese (CDC, 2016).

In this literature review, I will be incorporating a case report about a female patient in her late 50s who presented to the clinic already in a septic state secondary to cellulitis assessed on her left lower extremity. She is a type II diabetic and is also classified as morbidly obese with a

BMI of 43. The main emphasis of this literature review will be to look at the evidence-based findings associated with body habitus (obese vs. normal BMI) and mortality risk in adult patients diagnosed with sepsis. This literature review will not focus on the treatment methods for sepsis, but to a more novel degree, explore the significance of body habitus in relation to mortality risk of septic patients.

Case Report

Chief Complaint: 58-year-old Caucasian female with concerns of fever, chills, confusion, and forgetfulness for 1 day.

HPI: Jessica Brown was brought into the clinic today by her sister with acute concerns of fever, chills, confusion, and forgetfulness. Her symptoms started 1 day prior to coming into the clinic. She has a prior medical history of type II diabetes, hypertension, hyperlipidemia, and obesity (BMI 43). She is alert and oriented to person, place, time, and situation. She denies urinary symptoms, rash, pain, injury, cough/congestion, and exposure to a known illness. She does not routinely check her blood sugar. Her fever has remained elevated despite taking Ibuprofen within 2-3 hours of appointment. She has had no recent surgeries or antibiotic use. She is up to date with immunizations, including influenza and pneumonia.

Past Medical History

Medical:

1. Type II Diabetes
2. Hypertension
3. Hyperlipidemia
4. Obesity

Surgical:

1. Tubal ligation > 10 years prior

Medications:

1. ezetimibe (Zetia) 5mg tablet once daily
2. metoprolol (Lopressor) 50mg tablet two times daily
3. Lisinopril 10mg tablet once daily
4. Metformin 1,000mg once daily
5. Simvastatin (Zocor) 80mg once daily
6. Aspirin 325mg once daily
7. Fish Oil 1,000 mg once daily

Allergies: No known allergies

Family History: Father has type II diabetes and cardiovascular disease.

Social History: Married, she has 2 grown children. She quit smoking in 2002, had smoked ½ - 1 pack daily for 20 years. She is retired.

Review of Systems

Constitutional: Positive for fever and chills.

HENT: Negative.

Respiratory: Negative. Negative for cough and shortness of breath.

Cardiovascular: Negative for chest pain, heart palpitations, and leg swelling. No history of heart murmurs.

Gastrointestinal: Negative. Denies nausea, vomiting, and abdominal pain.

Genitourinary: Negative. Denies urinary urgency, dysuria, and hematuria.

Musculoskeletal: Negative.

Skin: Negative. Denies rash.

Neurological: Negative. Denies headache, syncope, problems with balance and coordination.

Psychiatric/Behavioral: Negative.

All other systems reviewed and are negative.

Physical Examination

Vital Signs: BP: 194/83, HR: 119, RR: 14, Temp: 104.7 F, O2: 93% RA, weight: 260 lb., height 5'5, BMI 43

Constitutional: She is alert and oriented x4. She appears well-developed and well-nourished.

Good hygiene.

HEENT: Normocephalic. Wears glasses. PERRLA, EOMs intact. Ears are symmetrical, no tenderness or discharge. Hearing, TMs, and ear canal are normal. Patent nares with moist pink mucosa. Uvula is midline, oropharynx is clear and moist, mucous membranes are normal.

Cardiovascular: Normal rate, regular rhythm, and normal heart sounds.

Pulmonary/Chest: Effort normal. Lung sounds are clear.

Abdomen: Soft, appearance normal. Bowel sounds are normal. No tenderness noted.

Neurological: She is alert and oriented to person, place, time, and situation.

Skin: Palm sized warm, erythematous, blanchable area to left lower shin. Tender to the touch.

No drainage noted. No other skin abnormalities noted.

Psychiatric: She has a normal mood and affect. Her speech is normal, behavior is normal. Judgment and thought content normal. Cognition and memory are normal.

Differential Diagnosis

Cellulitis, deep vein thrombosis, urinary tract infection, diabetic ketoacidosis, sepsis

Plan

Although the patient did not mention the erythematous area to her left lower shin, it was found during her physical examination. She states she first noticed it a couple days prior. Her symptoms, vital signs, and assessment are concerning for sepsis secondary to cellulitis assessed on the left lower extremity. CBC, CRP, CMP, and Lactic Acid were ordered. The provider in the nearest emergency room was contacted and the patient's case was discussed. He is willing to take over care of the patient as further workup and possible hospitalization is indicated. The patient transported to the emergency room via private vehicle, her sister drove her.

Follow up within 1 week after hospital discharge to assess infection status, hypertension, and hyperglycemia.

Labs

1. CBC, CRP, CMP, and Lactic Acid ordered and were drawn while patient was still in the clinic.
2. After the patient left the clinic, the following labs resulted and were noted to be abnormal: WBC 12.5 (high), Seg Neut Absolute 10.1 (high), CRP 144.4 (high), Glucose 266 (high), Sodium 132 (low), Chloride 94 (low), CO2 20 (low), Anion Gap with K 22 (high), and Lactic Acid 4.4 (high). All other laboratory findings were within normal limits.

Literature Review

The patient presented in the case report had an admitting diagnosis of sepsis secondary to cellulitis based on her physical examination and lab findings. In recent years, the correlation between body habitus (BMI) in septic patients and mortality rate have been evaluated. By understanding and establishing if there is a correlation, therapeutic strategies can improve and ultimately decrease the mortality rate in septic patients. The driving question is, will this

patient's morbidly obese habitus have a protective or an unfavorable impact on her mortality risk while being treated for sepsis? Again, this literature review will not focus on the treatment methods for sepsis, but to a more novel degree, explore the significance of body habitus in relation to mortality risk of septic patients. The obesity paradox and also the need for more research were two concepts quickly recognized in the ten articles that were analyzed for this literature review.

Obesity Paradox

Although obesity is known to have many negative connotations related to health, in recent years, obesity has been proposed to have a protective factor in sepsis. This phenomenon is being called the "obesity paradox" (Kalani et al., 2020; Papadimitriou-Olivgeris et al., 2016; Robinson et al., 2020; Wang et al., 2017). There have been many rationales implied to explain how obesity may be beneficial to patients during times of critical illness. When an obese patient is in a highly catabolic state, as they would be during sepsis, excess body fat or adipose tissue may serve as a source of fuel and energy during the disease process. Having a higher BMI and access to adipose tissue provides a nutritional reserve for patients in acute illnesses (Mewes et al., 2019; Wang et al., 2017). Adipose tissue also has a role in regulating immunity by expressing inflammatory mediators such a leptin, which is an anti-inflammatory adipokine (Mewes et al., 2019; Wang et al., 2017). Leptin levels are elevated at baseline in obese individuals and additionally, rise during septic states. Leptin levels have been found to be threefold higher in survivors of sepsis when compared to non-survivors and therefore have been viewed as protective (Wang et al., 2017). In addition to high leptin levels, adipose tissue has likewise been linked to increased production of tumor necrosis factor (TNF) and soluble TNF receptor. During

sepsis, increased soluble TNF receptor levels could reduce the harmful effects of TNF (Pepper et al., 2016).

Individuals with obesity have also been noted to have a higher incidence of arterial hypertension at baseline as a result of increased renin-angiotensin system activity (Kalani et al., 2020; Mewes et al., 2019; Pepper et al., 2016). This hypertension can be protective during times of septic shock where less vasopressor medication and fluid resuscitation may be indicated to maintain a safe blood pressure. Patients with higher BMIs were also noted to be less susceptible to secondary nosocomial infections, including *Enterococcus faecalis* infections, suggesting obese patients have a stronger immune response than patients with normal a BMI (Mewes et al., 2019).

Limitations of Current Research

Another common concept that was appreciated from the analyzed articles in this literature review was the need for more research to determine if obesity is beneficial or harmful to septic patients. A multitude of limitations and variations were recognized explaining why more research is indicated. First, accurate weight and height measurements to calculate BMI were a concern (Pepper et al., 2016; Trivedi et al., 2015). A well-defined explanation of how a patient's weight and height were acquired are essential to avoiding discrepancy and corrupting the validity of a study. Recorded weights may have been patient reported or taken after fluid resuscitation in an emergency department setting, changing a patient's BMI and ultimately, any research findings.

The source of infection for obese and morbidly obese patients also varied greatly when compared to non-obese patients (Gaulton et al., 2015). Soft tissue infections were often the culprit in the obese and morbidly obese populations. Patients with obesity are also typically younger and are less severely ill than those of normal body habitus (Gaulton et al., 2015).

Comorbidities are more common in overweight and obese patients than in normal weight patients (Atamna et al. 2017; Gaulton et al., 2015). Gaulton et al. (2015) further explain “...overweight, obese, and morbidly obese groups were more likely to have diabetes, hypertension, and congestive heart failure, and less likely to have a cancer or be immunocompromised” (p. 475). The decision to admit overweight and obese patients to intensive care units may be influenced by their comorbidities although they may be less acutely ill than someone with a normal BMI (Yeung & Eikermann, 2017). This could influence the mortality rate seen in septic patients because less ill patients would be receiving a higher level of care and likely have better outcomes.

When the volume of fluid given intravenously for sepsis fluid resuscitation did not follow a weight-based protocol, the lower volume of fluid per body weight was found to be both beneficial and harmful to obese patients in various studies (Trivedi et al., 2015; Yeung & Eikermann, 2017). It is recommended that future research be directed at better defining adequate fluid resuscitation and assessing fluid requirements in the obese population (Trivedi et al., 2015). By having a fluid resuscitation algorithm to follow for septic patients that accounts for body habitus, evidence would be more consistent.

Another noteworthy finding is the majority of research studies reviewed are categorized as retrospective which makes them more vulnerable to collection bias and inaccurate data collection (Atamna et al. 2017). More rigorous research needs to be completed to evaluate and understand the role of obesity in septic patients. The previously discussed limitations would also need to be considered and incorporated in upcoming research to better define the influence of obesity. By attaining this, new therapeutic strategies/guidelines could be established to improve the prognosis of septic patients. Unfortunately, for the patient presented in the case report, a

definitive answer of whether her morbidly obese habitus would be protective or harmful while being treated for sepsis cannot be proven at this time.

Learning Points

- Patients who are overweight or obese may have a decreased risk of mortality compared to patients with a normal BMI when being treated for sepsis.
- Obesity appears to have many protective variables in patients who are septic; however, more research is needed to verify this.
- Many research studies that were analyzed had limitations and variations that did not provide concrete evidence at this time regarding the protective or harmful effects of obesity during sepsis.
- With continued research, new therapeutic strategies/guidelines could be established to improve the prognosis of septic patients.

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