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Marilyn T. Haupt and Mary Jane Reed

The Obesity Paradox **583**

Dennis E. Amundson, Svetolik Djurkovic, and Gregory N. Matwiyoff

The term “obesity paradox” refers to the observation that, although obesity is a major risk factor in the development of cardiovascular and peripheral vascular disease, when acute cardiovascular decompensation occurs, for example, in myocardial infarction or congestive heart failure, obese patients may have a survival benefit. In addition, it has been suggested that obese patients tend to fare better after certain surgical procedures, such as coronary artery bypass surgery. Moreover, it appears that obese men with chronic hypertensive heart disease live longer than men of normal weight. Mounting evidence shows that obesity alone may confer a survival benefit independent of age, medical care, or therapy. Perhaps the definition of obesity needs to be revisited, and it is also possible that all fat is not equal.

Effects of Obesity by System and Critical Care Considerations

Pulmonary System and Obesity **597**

Doyle D. Ashburn, Angela DeAntonio, and Mary Jane Reed

There are several challenges in the management of respiratory failure in the obese population. Pulmonary physiology is significantly altered leading to reduced lung volumes, decreased compliance, abnormal ventilation and perfusion relationships, and respiratory muscle inefficiency. These complications can lead to a prolonged requirement for mechanical ventilation and increased intensive-care-unit length of stay.

Cardiovascular Considerations in Critically Ill Obese Patients **603**

Mitchell K. Craft and Mary Jane Reed

With a growing obese population, preventative and therapeutic strategies need to be developed to combat the complex cardiac pathophysiology related to obesity. This is paramount in the management of critically ill obese patients. This article highlights these strategies.

Acute Kidney Injury in the Critically Ill, Morbidly Obese Patient: Diagnostic and Therapeutic Challenges in a Unique Patient Population **607**

Ion D. Bucaloiu, Robert M. Perkins, William DiFilippo, Taher Yahya, and Evan Norfolk

The growing burden of morbid obesity (body mass index >40 kg/m²) on critical care resources translates to a significant incidence of acute kidney injury (AKI) in morbidly obese (MO), critically ill patients. This article

examines the literature pertinent to AKI in critically ill MO patients. After a concise review of the available epidemiologic data regarding the incidence of acute renal injury in MO individuals, the authors review the limitations and available tools for estimation of renal function in the MO population (with emphasis on the critical illness). Also described are several specific types of renal injury previously described in this population that are applicable to the critical care setting. Lastly, the authors review some of the challenges and limitations in providing renal support to critically ill MO individuals, and identify potential areas for future research in this population.

Gastrointestinal System and Obesity

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Doyle D. Ashburn and Mary Jane Reed

Several significant changes occur in the gastrointestinal system with obesity that can effect management in critical illness. This population is at risk for gastroesophageal reflux disease (GERD), abdominal compartment syndrome, nonalcoholic fatty liver disease (NAFLD), and an increased incidence of cholelithiasis. It is important for critical care providers to be aware of these potential complicating factors.

Immunologic Changes in Obesity

629

Mitchell K. Craft and Mary Jane Reed

A growing body of literature suggests multifaceted alterations to the immune function in obese patients compared with a lean cohort. Although treatment in the intensive care unit has an associated risk of infectious complications, which, if any, of these immunologic alterations are causal is unclear. Obesity clearly causes abundant alterations to the immune system. Overall, the aggregate effect seems to be chronic activation of inflammatory mediators.

Endocrine System and Obesity

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Doyle D. Ashburn and Mary Jane Reed

Obesity is associated with significant alterations in endocrine function. An association with type 2 diabetes mellitus and dyslipidemia has been well documented. This article highlights the complexities of treating endocrine system disorders in obese patients.

Venous Thromboembolic Disease and Hematologic Considerations in Obesity

637

Mitchell K. Craft and Mary Jane Reed

Venous thromboembolic disease continues to be a major source of morbidity and mortality, with obese patients who are critically ill presenting some of the most at-risk patients. As the literature evolves, it has become clear that there is a complex relationship between obesity and thrombosis and atherogenesis. It is true that many of these conditions are reversible with weight loss; however, obesity remains on the rise. Management of obese patients must incorporate and consider these intricate changes in an attempt to improve patient outcomes.

- Airway Management in the Obese Patient** 641
- William A. Loder
- Any patient can have a difficult airway, but obese patients have anatomic and physiologic features that can make airway management particularly challenging. Obesity does not seem to be an independent risk factor for difficult intubation but is one of the several factors that need to be considered as part of an airway evaluation. To effectively manage airways in obese patients, health care providers working in the intensive care unit setting must be proficient in airway evaluation and management in all types of patients. This article discusses the risk factors for a difficult airway and the methods of managing the airway.
- Procedures in the Morbidly Obese Critically Ill***
- Vascular Procedures in the Critically Ill Obese Patient** 647
- Omar Rahman and Laurel Willis
- The increasing societal prevalence of obesity is consequential to the increasing number of critically ill obese patients. Vascular procedures are an essential aspect of care in these patients. This article reviews the general, anatomic, and physiologic considerations pertaining to vascular procedures in critically ill obese patients. In addition, the use of ultrasonography for these procedures is discussed.
- Ultrasound-Assisted Lumbar Puncture in Obese Patients** 661
- Robert Strony
- The use of ultrasound to mark landmarks for diagnostic lumbar puncture has been described in emergency medicine as well as in the anesthesia literature. One of the most difficult scenarios arises when obese patients with a body mass index (BMI) of greater than 30 present to an acute care setting, such as the emergency department or intensive care unit and require diagnostic LP. This article discusses lumbar puncture in patients with a high BMI.
- Beside and Radiologic Procedures in the Critically Ill Obese Patient** 665
- Michelle Olson and Chris Pohl
- Performance of procedures upon the obese critically ill patient in the ICU or in the radiology suite, require certain considerations. Additional staff, equipment and proper ergonomics are often necessary to perform these procedures safely for both patient and staff.
- Tracheostomy in Critical Ill Morbidly Obese** 669
- Michael Clark, Scott Greene, and Mary Jane Reed
- Nutrition in Critically Ill Obese Patients** 671
- Naeem Raza, Peter N. Benotti, and Christopher D. Still
- Critically ill obese patients require timely nutrition in the intensive care unit. Hypocaloric, high protein nutritional feeding might have a role in critically ill obese patients. Although critically ill obese patients need special medical and nutritional care as do nonobese patients in the ICU, there are some differences in the literature about the initiation, routes, and nature of

nutritional support. This article reviews the norms of nutritional care among critically ill obese patients and the differences between these patients and those with a normal BMI.

Pharmacotherapy in the Critically Ill Obese Patient

679

Charles J. Medico and Patrick Walsh

Despite the growing epidemic of obesity in the United States, dosing medications in such patients remains poorly studied and understood. Most recommendations are based on small independent studies, case reports, and expert opinion. Applying manufacturer kinetics and dosing recommendations in the obese patient may result in toxicity or treatment failure, leading to increased morbidity, mortality, and hospital length of stay.

Special Populations

Trauma in Obese Patients

689

Christine C. Toevs

As the American population grows larger in terms of weight and body mass index each year, a greater percentage of patients admitted to the trauma service are overweight or obese. Obese patients do not have the same injury patterns or outcomes of normal-weight patients. This article reviews some of the latest data regarding the injury patterns, outcomes, and areas of further studies in the obese trauma population.

Bariatric Surgery Patients in the ICU

695

Mary Jane Reed and Jon Gabrielsen

As the incidence of bariatric surgery continues to increase, the medical community should be aware of the most common procedures, resultant anatomy, and possible complications to be better prepared to care for these patients in all situations.

Special Considerations in the Critically Ill Morbidly Obese Child

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Karen Allison Bailey

Obesity has been recognized as an increasing problem not only in North America but globally. With a significant rise in the prevalence of obesity amongst children and adolescents over the past 20 years, the comorbidities associated with obesity are also now emerging at an earlier age. These comorbidities cause specific concern and require special consideration when the morbidly obese child becomes critically ill.

Critical Care of the Morbidly Obese in Disaster

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James Geiling

The prevalence of obesity in the United States is increasing, with extreme morbid obesity of body mass index greater than 40 increasing twice as fast as obesity in general. With the increased weight comes an increased risk of comorbidities, including type 2 diabetes mellitus, cardiovascular disease, respiratory problems such as obstructive sleep apnea or restrictive lung

disease, skin disorders such as intertrigo and cellulitis, and urinary incontinence. Thus, patients exposed to a variety of disasters not only are increasingly overweight but also have an associated number of coexistent medical conditions that require increased support with medical devices and medications. This article focuses on management of the morbidly obese patients during disasters.

Special Populations Critical Care Considerations of the Morbidly Obese Pregnant Patient 715

Marie R. Baldisseri and Margaret D. Larkins-Pettigrew

The critically ill pregnant patient poses a unique challenge to the clinician, requiring a thorough understanding of normal and abnormal maternal and fetal physiology associated with pregnancy. The morbidly obese patient presents even greater challenges to the clinician, and morbidity and mortality are proportionately increased. Because increased numbers of obese pregnant women are now admitted to intensive care units, practitioners must be aware of the physiology associated with both pregnancy and obesity. A multidisciplinary approach is imperative to prevent both maternal and fetal morbidity and mortality for these very complex patients, especially when they are admitted to the ICU with critical illness.

Afterword: Sensitivity in Caring for the Obese Patient 733

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