

REVIEW ARTICLE

Optimizing Critical Care for the Obese Population: From Physiology to Practice

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ABSTRACT

Obesity poses distinct issues in the Intensive Care Unit (ICU) owing to its related physiological changes, comorbidities, and the intricacies of management. Obese individuals face heightened risks for respiratory problems, cardiovascular issues, and metabolic dysregulation.

Effective management necessitates customized strategies:

Respiratory Support: Elevated positive end-expiratory pressure (PEEP), prone positioning, as well as tailored ventilatory modifications are crucial for managing impaired breathing mechanics and averting lung injury.

Hemodynamic Management: Careful fluid management and non-invasive monitoring are needed to address altered cardiovascular dynamics and optimize perfusion.

Pharmacologic Adjustments: Dosage modifications for sedatives, analgesics, and vasoactive agents accommodate altered drug metabolism and distribution.

Nutritional Support: Hypocaloric, high-protein feeding is advised to meet energy needs while avoiding overfeeding, ideally guided by indirect calorimetry.

Thromboprophylaxis and Mobility: Heightened risk for venous thromboembolism (VTE) requires higher anticoagulant doses and early mobilization using bariatric equipment. Furthermore, obesity can also caused obesity paradox, an unexpected survival benefit in septic patients with obesity, likely due to enhanced energy reserves, RAAS activation, and anti-inflammatory effects.

A multidisciplinary and individualized approach is critical to improving outcomes in obese ICU patients, highlighting the need for updated clinical guidelines and further research tailored to this population.

Keywords: Hemodynamic; ICU; Obesity; Respiratory; Ventilator.

INTRODUCTION

The prevalence of obesity is increasing worldwide. Excess fat tissue can have anatomical and physiological effects that have implications for critical illness. Owing to the elevated obesity prevalence, a growing cohort of obese patients is being referred to critical care units (ICUs). Approximately 25% of individuals admitted to the ICU are classified as overweight, obese, or morbidly obese, with sepsis being the predominant cause of such admissions¹. These factors increase the complexity of clinical care and impact patient outcomes.^{2,3}

DISCUSSION

Obesity is closely linked to physiological alterations and modified medication metabolism, complicating ICU care⁴.

A. Physiological Changes in Obesity

1. Respiratory system

- a. Decreased functional residual capacity and lung volume in obese individuals elevate the risk of hypoventilation, hypoxemia, and airway obstruction., making airway management very risky because it can cause more rapid oxygen desaturation during intubation procedures².

- b. Accumulation of fat on the abdominal and chest wall can reduce lung compliance and increase the work of breathing².
- c. Accumulation of fat around the neck and pharynx can narrow the upper airway, increasing the risk of obstruction and making visualization difficult during intubation³
- d. Some individuals with obesity may experience alveolar hypoventilation called Obesity-Hypoventilation Syndrome, which can lead to hypoxemia and hypercapnia and a higher prevalence of OSA, which is associated with changes in airway anatomy that can make intubation difficult⁵.

2. Cardiovascular System

- a. Increased risk of Hypertension, heart failure, arrhythmia, and venous thromboembolism can all be brought on by elevated peripheral vascular resistance and sodium retention⁶.
- b. Obesity elevates blood volume and cardiac output to satisfy the metabolic demands of excess adipose tissue⁷.

3. Endocrine and Metabolic System

- a. Excessive Excess adipose tissue adds to insulin resistance and elevates the chance of developing type 2 diabetes⁸.
- b. Elevated triglyceride levels and decreased HDL cholesterol are often found in obese individuals⁹

4. Difficult intravenous access

- a. Difficult Intravenous Access (DIVA) poses a barrier even for seasoned healthcare personnel and may occur in as many as 59% of patients¹⁰.
- b. Utilizing ultrasonography (USG) in patients with DIVA facilitates a high success rate for first-attempt¹⁰. The efficacy of intravenous therapy is contingent upon the type of intravenous (IV) catheter employed, as short peripheral catheters (SPCs) are typically insufficiently long to remain securely within the vein¹⁰.
- c. It is advisable that two-thirds of the catheter's length be retained within the vein¹⁰. This can be difficult in obese people. Long peripheral catheters (LPCs) or midline catheters (MCs) may be

deemed appropriate for this patient cohort¹⁰.

B. Airway Management Strategies in Obesity

In this context, many solutions are frequently advised, including the use of a ramping posture, pre-oxygenation using positive pressure breathing, and the utilization of videolaryngoscopy^{11,12}. (Figure 1)

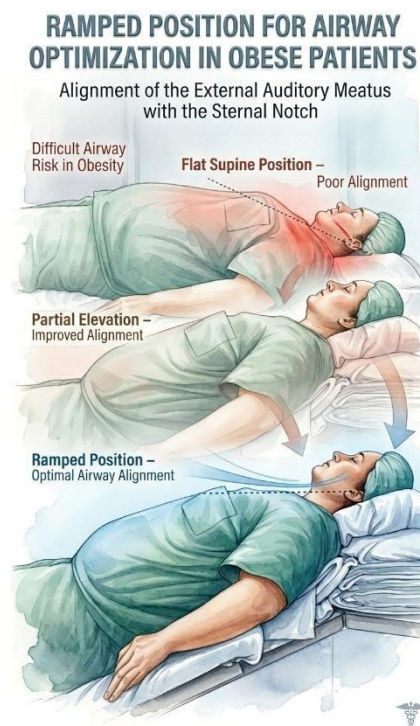


Figure 1. modified ramped position.

Adapted from Kim, 2021¹³

Traditional ventilation with bag-mask ventilation (BMV) may lead to fast desaturation in morbidly obese individuals. Numerous studies

indicate that pre-oxygenation with Continuous Positive Airway Pressure (CPAP) or Non-Invasive Ventilation (NIV) enhances oxygenation and permits extended intubation durations¹¹.

Apnea Oxygenation

Ramachandran et al. demonstrated that oxygen delivery with a nasal cannula at a flow rate of 5 l/min in obese patients significantly prolonged the duration of $\text{SpO}_2 \geq 95\%$ during difficult laryngoscopy¹⁴. A similar study by Moon et al. show a result that the administration of oxygen 15 l/minute via standard nasal cannula will receive 103 seconds safe apnea duration longer than the patient who is not given oxygen administration. Gaszyński assessed the application of nasal Continuous Positive Airway Pressure (CPAP) in obese individuals during intubation attempts. Oxygen 100 % was administered from the gas outlet of the anesthesia machine with flow adjustments and the valve set to maintain an airway pressure of 15 cmH₂O (1.74 kPa). All patients achieved 6 minutes of apnea with SpO_2 remaining above 94% after that

period. The authors observed that the use of apneic oxygenation methods in obese patients improved oxygenation efficacy and prolonged apnea time, both of which can be beneficial during difficult airway management¹⁴.

1. Ventilation Management Strategy

Obesity causes decreased lung volume and compliance, making mechanical ventilation more difficult and increasing the risk of ventilator-related complications¹¹. Application such as increasing PEEP and using the prone position are beneficial in optimizing oxygenation and protecting the lungs in individuals with obesity¹¹.

Obese patients experience increased breathing and impaired gas exchange. Some causes of increased breathing in obese patients include:

- a. The effect of gravity on respiration concerning the abdominal cavity, thoracic cavity, and chest wall. Elevated airway resistance resulting from reduced airway diameter and a higher prevalence of asthma
- b. Increased Enhanced tissue resistance elevates the

respiratory workload.

- c. Airway closure may occur in dependent lung regions during expiration. This means that these areas require increased airway pressure for lung inflation. If airway closure persists, distal alveoli can collapse. This can be seen due to gas absorption or the use of high oxygen concentrations. The use of pure oxygen can trigger lung collapse within minutes, while the use of room air can trigger lung collapse within hours¹¹.

Ventilation strategies for obese patients in the ICU

Obese individuals exhibit increased vulnerability to respiratory complications, such as Acute Respiratory Failure (ARF) and Acute Respiratory Distress Syndrome (ARDS).. Several studies have suggested that non-invasive ventilation management, such as Non-Invasive Ventilation (NIV), should be considered for the prevention and management of ARF, although scientific evidence is still

limited, especially when compared with High Flow Nasal Cannula (HFNC)¹¹.

Following intubation for invasive mechanical ventilation, obese patients exhibit increased susceptibility to lung collapse, necessitating elevated PEEP levels to mitigate this risk. The use of low tidal volumes based on predicted body weight (PBW) is recommended for both patients with and without ARDS¹¹. The recruitment maneuver (RM) is not recommended, and its use is based on a risk/benefit assessment for each patient. Prone positioning can be used in obese patients with severe ARDS¹¹.

In clinical settings, Devine formula is often used as a standard formula for calculating PBW.

$$PBW = 50 \text{ (for males) or } 45.5 \text{ (for females)} + 0.91 \times [(height \text{ (cm)} - 152.4)] = 0.91 \times height - [88.7 \text{ (for males) or } 93.2 \text{ (for females)}]^{15}$$

1) Recruitment Maneuver (RM)

Increased Increased airway pressure may result in decreased venous return, which can subsequently lead to reduced cardiac preload,

diminished cardiac output, and lowered systemic blood pressure. The risk of barotrauma, including pneumothorax or pneumomediastinum, is heightened in patients with pre-existing structural lung damage, such as emphysema, or those undergoing mechanical manipulation of pre-inflamed lungs¹¹. Consequently, RM is typically not advised, and its application should be determined by a risk/benefit assessment on a patient-specific basis¹¹.

2) Positive End Expiratory Pressure (PEEP)

PEEP does not directly induce alveolar recruitment; instead, it functions to prevent alveolar derecruitment by maintaining alveolar patency. Protective ventilation strategies can enhance clinical outcomes in patients who do not have ARDS¹¹. Obese patients experience increased pressure from fatty tissue on the pleural space, alongside elevated closing pressures, which heightens their susceptibility to pulmonary

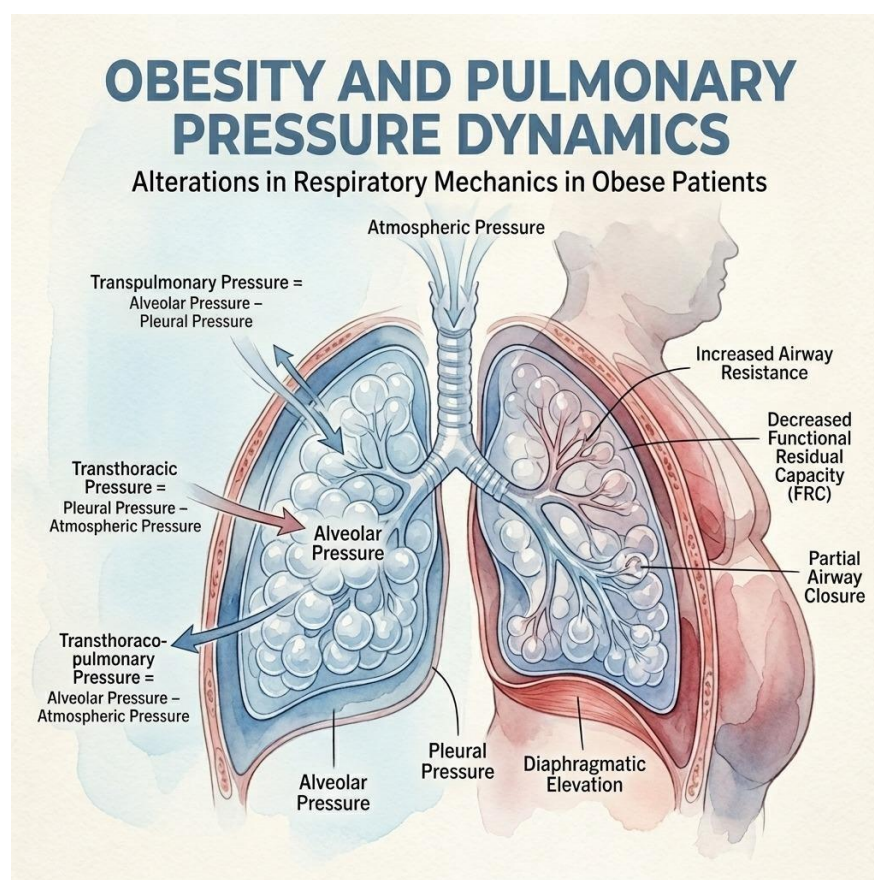


Figure 2. Effect of Obesity toward Respiration System.
Adapted from De Jong, 2020 ¹¹

complications¹¹. (Figure 2).

In patients undergoing bariatric surgery, PEEP was established within a pressure range of 10 to 26 cmH₂O, with a mean pressure of 18 cmH₂O, effectively restoring the end-expiratory lung volume (EELV) to pre-intubation and mechanical ventilation levels¹¹. A separate study identified a PEEP level exceeding 15 cmH₂O¹¹.

This suggests that the optimal effect of PEEP varies according to the needs of each patient¹¹.

3) Tidal Volume

Limiting tidal volume reduces ventilator-associated lung injury and inflammation in patients with and without ARDS¹¹. Normal VT using PBW is determined by expected lung volume, influenced by the patient's height and sex, and seeks to minimize the VT/EELV ratio and mechanical lung stress¹¹. Early spontaneous ventilation preserves diaphragmatic tension, redistributes ventilation to dependent lung areas, prevents diaphragmatic muscle atrophy from relaxation, and shortens mechanical ventilation duration¹¹.

2. Management of Obese Patients with Acute Respiratory Failure

Non-invasive strategies should start with optimizing body positioning, including the reverse Trendelenburg, beach chair, or sitting positions¹¹. Adjusting the patient's position can improve lung compliance and facilitate better gas exchange in individuals with morbid obesity¹¹. A clinical trial compared non-invasive ventilation (NIV) with standard oxygen and high-flow nasal cannula (HFNC) in patients with hypoxemic acute respiratory failure (ARF). The results indicated a lower mortality rate in the HFNC group compared to NIV, suggesting a potential adverse effect of NIV. NIV can be utilized in obese patients, particularly those who are morbidly obese, by employing Positive End-Expiratory Pressure (PEEP) to enhance oxygenation, lung volume, and alveolar recruitment¹¹.

In a comparison of 21 obese ARDS patients with non-obese ARDS patients, both groups exhibited similar improvements in alveolar recruitment and oxygenation when PEEP was raised

from 5 to 15 cmH₂O¹¹. Abdominal pressure and chest wall elasticity were comparable in both groups. Fumagalli et al. observed significant enhancements in oxygenation and lung elasticity with higher PEEP (22 cmH₂O) versus lower PEEP (13 cmH₂O)¹¹. Higher PEEP was chosen according to transpulmonary pressure, whereas lower PEEP was determined using PEEP/FiO₂ tables¹¹. Abdominal pressure was neither measured nor reported. Prone positioning is crucial for obese ARDS patients. This therapy's safety and effectiveness are

comparable in obese and non-obese patients; however, the PaO₂/FiO₂ ratio is significantly higher in obese patients following prone positioning. Prone positioning is the preferred therapy for patients with severe ARDS and obesity. The mechanism of action, special considerations, and clinical effects are outlined in Figure 3¹¹.

3. Weaning and Extubation

Atelectasis prevention should begin immediately post-extubation using CPAP or NIV. To enable early extubation, sedation must be stopped promptly, and benzodiazepines should be avoided

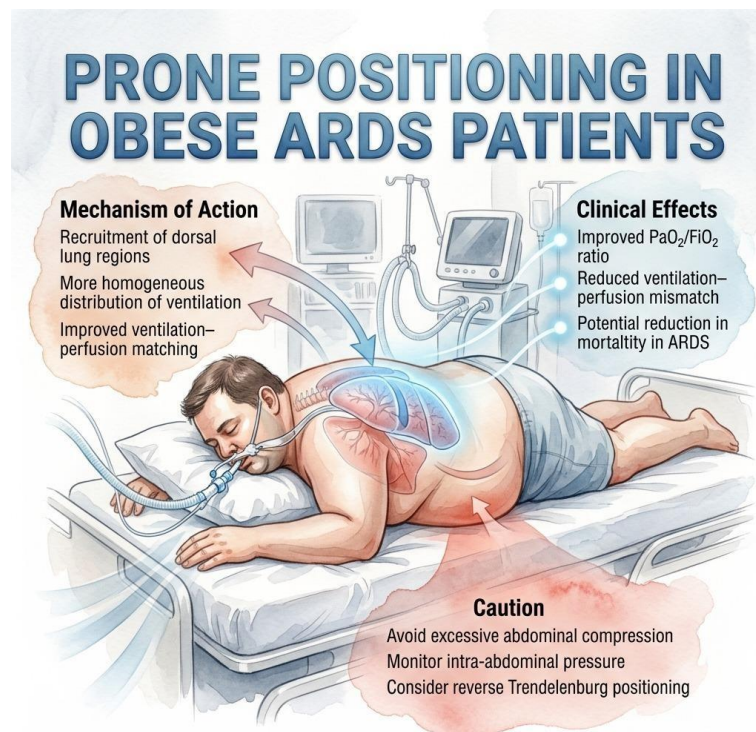


Figure 3. Prone position in patients with obesity.
Adapted from De Jong, 2020 (11)

because of their prolonged effects in obese patients¹¹.

Prophylactic NIV post-extubation can lower ARF risk by 16% and decrease ICU length of stay. A randomized controlled trial in morbidly obese individuals with morbid obesity undergoing bariatric surgery indicated that ventilatory function improved more significantly with immediate CPAP use after extubation than with delayed initiation¹¹.

C. Hemodynamic Management

Hemodynamic instability is a significant issue in the management of obese patients in the ICU., as these patients have pharmacokinetic and pharmacodynamic differences¹⁶. Monitoring fluid status and cardiovascular function in obese patients is difficult, with classic methods such as echocardiography and invasive monitoring often providing limited accuracy in these patients^{11,17}.

Managing cardiovascular issues in obese ICU patients is complex due to their distinct hemodynamic profiles, including elevated blood volume, cardiac output, and systemic vascular resistance. Physiological

changes affect the cardiovascular system, raising the risk of left ventricular hypertrophy, heart failure, and hypertension¹⁸.

Obesity increases cardiovascular risk due to both the condition itself and related medical issues such as hypertension, diabetes, insulin resistance, and sleep apnea syndrome¹⁹. Obesity causes both anatomical and physiological changes in the heart that may progress to cardiac failure. Changes in the myocardial structural is associated with a higher risk of atrial fibrillation and unexpected cardiac arrest¹⁹.

Fluid Management Strategies in Obese Patients

The Surviving Sepsis Campaign (SSC) recommendations advocate for the administration of at least 1 mL/kg (ideal body weight) of crystalloid solution. However, the SSC guidelines do not specifically address obese patients²⁰. Fluid management strategies in obese patients differ, focusing on ideal body weight (IBW) versus actual body weight (ABW)²⁰. The difference in fluid effects has sparked debate over infusion strategies utilizing IBW versus non-IBW (ABW) approaches²⁰.

Taylor et al. introduced a fluid management strategy that may offer enhanced benefits for obese patients²¹. The Adjusted Body Weight (AdjBW) fluid strategy offers fluid volumes that are lower than those based on Actual Body Weight (ABW) but higher than those based on Ideal Body Weight (IBW)²². (OR 0,29; CI 95% 0,11–

0,79)²¹. The most common weight measures used in calculating drug doses in the ICU include:

- Total Body Weight (TBW)
- Ideal Body Weight (IBW)
- Lean Body Weight (LBW)
- Adjusted Body Weight (AdjBW)²¹

Each approach is indicated based on the patient's condition and the type of treatment administered. (Table 1)

Table 1. Common Body Weight Measurements²²

Body Weight	Equations
<i>Body Mass Index (kg/m²)</i>	<i>Total Body Weight (TBW) / height (m)²</i>
	Man: 50 kg + 2,3 kg/inch (height > 5 ft)
<i>Ideal Body Weight (kg)</i>	Woman: 45,5 kg + 2,3 kg/inch (height>5 ft) Man: (9.270 × TBW) / (6.680 + 216 × BMI)
<i>Lean Body Weight (kg)</i>	Woman: (9.270 × TBW) / (8.780 + 244 × BMI) Correction Factor (CF) × (TBW – IBW) + IBW,
<i>Adjusted Body Weight (kg)</i>	Where CF = 0,4

This equation is used to calculate the weight distribution of obese patients in safe and effective drug doses²².

D. Pharmacological Consideration for Obese Patients

The pharmacological management of obese patients is complicated by alterations in body composition that influence drug volume of distribution and clearance¹⁵. Lipophilic drugs increase their

volume of distribution in obese patients, requiring dose adjustments to prevent toxicity or failure to meet therapeutic targets¹⁵.

In obese ICU patients, drug management necessitates dose adjustments to prevent underdosing or overdosing, as obesity influences drug distribution and clearance (4), for example

- Lipophilic drugs can accumulate in fatty tissue, causing prolonged effects.

- Hydrophilic drugs may have a shorter duration of action due to altered body fluid distribution²³.

Weight-based dosing is generally recommended for some drugs, but individual patient factors and comorbidities should also be considered²⁴.

1. Vasopressors

- All commonly used vasopressors are hydrophilic, as evidenced by negative log *P* values²². Small distribution volumes and rapid clearance lead to short half-lives for these agents, often requiring continuous intravenous infusions for administration²².
- For vasopressor medications administered via continuous infusion in obese patients, both non-weight-based and weight-based medications, it is recommended to use IBW or AdjBW for the initial dose. This is important to minimize the risk of error²².

2. Antihypertensive Drugs

- Antihypertensive drug

administration for managing hypertension in obese patients requires individual adjustment due to fluid shifts and increased myocardial workload prevalent in this population²⁵.

- Drug such as ACE inhibitor is frequently used but require close monitoring due to potential impacts on renal perfusion and myocardial function²⁶.

3. Analgesia and Sedation

When implementing strategies for analgesia, sedation, or delirium, guidelines should be followed for obese patients, as for non-obese does. These strategies include:

- Targeting mild sedation,
- Using a validated rating scale,
- Provides daily sedation interruptions,
- Performing spontaneous breathing trials,
- Regular delirium screening.

The recommended drugs based on the guidelines are opioid analgesics, non-opioid analgesics, ketamine, propofol, dexmedetomidine, benzodiazepines and etomidate.

- Opioid Analgesics: The dose is

titrated gradually according to clinical effect and using IBW or AdjBW, particularly in morbidly obese individuals ($\text{BMI} \geq 40 \text{ kg/m}^2$).

- Non-Opioid Analgesics: Does not require weight-based calculations.
- Ketamine: It is recommended to use IBW or AdjBW in obese patients, particularly in morbidly obese individuals ($\text{BMI} \geq 40 \text{ kg/m}^2$).
- Propofol: Dose adjustments are required. Using ABW can cause supratherapeutic concentrations, resulting in drug levels in the body exceeding those required for therapeutic effect, which can increase the risk of side effects or toxicity. Therefore, using a dose based on IBW/AdjBW is safer.
- Dexmedetomidine: Dose adjustment using IBW or AdjBW may prevent supratherapeutic concentrations.
- Benzodiazepines: It is safer to calculate the initial dose and continuous infusion using the IBW or AdjBW, with small

increments titrated until the desired effect is achieved²².

- Etomidate: ABW is applicable for obese patients with $\text{BMI} < 40 \text{ kg/m}^2$, while IBW or AdjBW is recommended for those with $\text{BMI} \geq 40 \text{ kg/m}^2$ ²².

These medications are part of evidence-based guidelines aimed at reducing complications in critically obese ICU patients.²²

E. Nutritional Needs

Enteral nutrition is favored over parenteral nutrition due to fewer complications and enhanced gastrointestinal integrity support²⁷.

In obese patients, even though they have excess body fat, many are at risk of malnutrition due to poor eating habits or underlying metabolic disorders. Nutritional support should be balanced to prevent overfeeding, as it may cause hyperglycemia, increase the risk of infection, and prolong the need for mechanical ventilation. In general, a high-protein, hypocaloric diet is recommended to ensure optimal nutrition and prevent further complications associated with

obesity²⁸.

Body Mass Index (BMI) may not consistently reflect a linear correlation with an individual's cardiometabolic status or risk of severe illness. Recent literature describes a J-shaped pattern relating BMI to mortality risk during critical illness, though the concept remains debated (29). The concept known as the obesity paradox refers to the observation that patients who are overweight and obese frequently exhibit reduced mortality compared to those with a normal body weight or severe obesity²⁹.

The Obesity Paradox

The obesity paradox describes a phenomenon in which obese patients demonstrate a survival advantage over normal-weight patients, particularly in the setting of sepsis. This may be due to:

1. Higher metabolic rates and the inability of adipose tissue to produce immunomodulatory molecules that protect against sepsis are observed in overweight and obese patients, but not in those with morbid obesity²¹

2. The energy reserves contained in adipose tissue can help sustain the catabolic processes triggered by sepsis¹.
3. In obese patients, heightened RAAS function frequently leads to hypertension; however, this may serve as a protective mechanism during sepsis by decreasing the requirement for vasopressors, which have numerous side effects¹.
4. The immunomodulatory role of adipose tissue in obese individuals leads to reduced levels of pro-inflammatory cytokines during severe infections or acute lung injury. This is believed to be linked to chronic inflammation due to obesity.

Nutrition Guidelines for Obese Critically Ill Patients

Nutritional guidelines for critically ill obese patients are scarce. Organisations like ASPEN, SCCM, and ESPEN have issued recommendations for patients with obesity (29). An individualised nutritional care approach for obese patients is recommended.

Optimal nutritional support in obese patients is challenging because of changes in nutrient metabolism and pharmacokinetics, particularly in the ICU, which may interfere with both drug delivery and nutrition management²⁹. The elements contributing to difficulties in caring for obese patients in critical illness are shown in Figure 4²⁹. The elements contributing to difficulties in caring for obese patients in critical illness are shown in Figure 4²⁹.

The recent ASPEN/SCCM guidelines addressed five key questions regarding nutrition therapy for critical care patients:

1. Evaluation and Detection of Malnutrition

ESPEN, ASPEN/SCCM : Assessing malnutrition in the ICU must be based on general clinical evaluation until standardized validated tools are available²⁹.

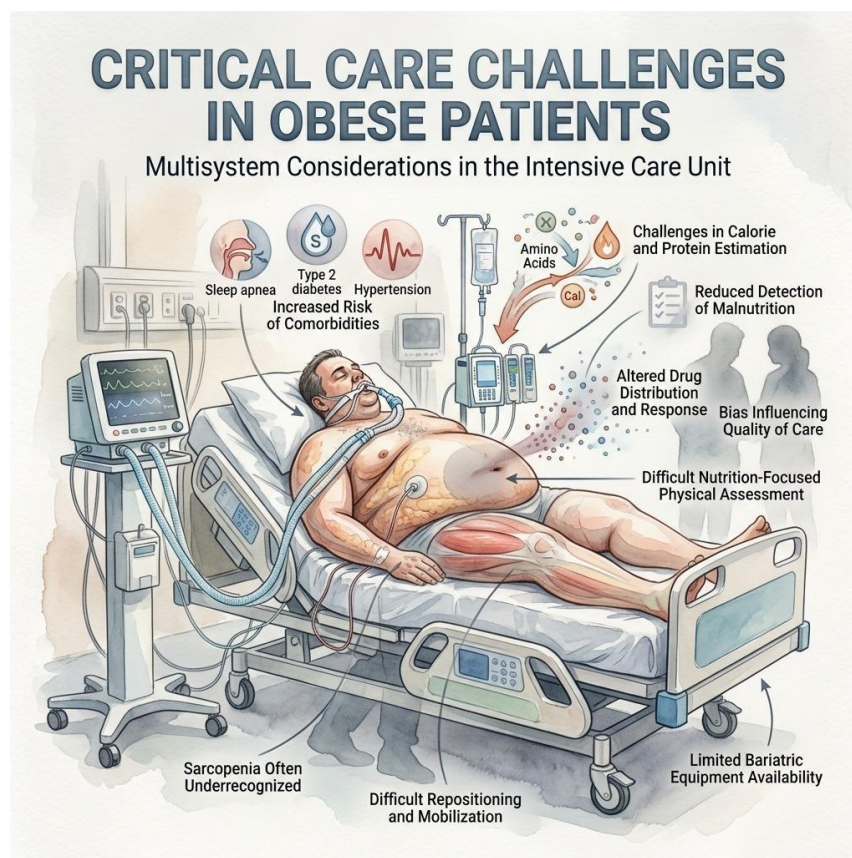


Figure 4. Factors complicating the care of critically ill patients with obesity. Adapted from Dickerson, 2022²⁸

Assessment of obese patients must account for potential underlying malnutrition, considering:

- Clinical conditions,
- Signs and symptoms of macro/micronutrient deficiencies,
- Poor muscle quality despite muscle mass²⁹.

Obese patients require monitoring for refeeding syndrome risk during treatment²⁹. This approach seeks to facilitate early detection and management of malnutrition, frequently obscured in obese individuals, to avert additional metabolic complications²⁹.

2. Energy Requirements Estimation

ESPEN: In obese patients, energy intake should be determined by Indirect Calorimetry (IC)²⁹. In the absence of IC, energy intake can be determined using this formula:

Energy intake = $(\text{Actual body weight} - \text{Ideal body weight}) \times 0.25 + \text{Ideal body weight}$.

ASPEN/SCCM:

- Use IC whenever possible.
- If IC is not available, use a simple BMI-based predictive equation:
 - 11 – 14 kcal/kg actual body weight/day for patients with BMI 30 – 50
 - 22–25 kcal/kg ideal body weight/day for patients with BMI > 50²⁹.

3. Estimating Protein Requirements, Identifying and Managing the Risk of Sarcopenic Obesity

ESPEN:

- Evaluation of protein intake can be performed using urine nitrogen measurements or assessment of lean body mass with CT scans or other techniques²⁹.
- In the absence of the methods, protein intake should be aimed at 1.3 g/kg AdjBW/day
- Protein needs may increase in critically ill obese patients²⁹.

ASPEN/SCCM:

- Recommended protein intake:
 - 2 g/kg IBW/day for patients with BMI 30 – 39.9
 - 2.5 g/kg IBW/day for patients

with BMI > 40

This approach addresses the protein requirements of critically obese patients, particularly those susceptible to sarcopenic obesity, which involves low muscle mass and increased body fat. This strategy prevents excessive muscle catabolism and maintains optimal metabolic balance²⁹.

4. Choosing the Ideal Nutrition Regimen

ASPEN/SCCM: Providing patients with a hypocaloric diet enriched in protein without significant renal or hepatic impairment²⁸. Nutritional strategies must be individualized to increase protein intake without excessive feeding. The regimen selection adapts to changing nutritional needs during the disease progression²⁹.

5. Use of IMN (Immunonutrition)

ASPEN/SCCM: The immune hyperreactivity seen in obesity may be viewed as a prospective benefit of immunomodulating formulations, insufficient research data precludes definitive

recommendations currently²⁹.

- The benefit of IMN for routine use in obese ICU patients remains uncertain²⁹
- IMN is recommended for patients with traumatic brain injury (TBI) and post-surgical care in the ICU²⁹.
- IMN should be considered for patients with severe trauma²⁹.

F. Thromboprophylaxis in Obese Patients in the ICU

Venous thromboembolism (VTE) exemplifies an obesity-related comorbidity that may negatively affect the efficacy of VTE prophylaxis and treatment due to altered pharmacokinetics and pharmacodynamics. Obesity during critical illness elevates VTE risk due to cytokine activation and proangiogenic factors, leading to a pro-thrombotic and dysfunctional fibrinolytic state³⁰.

1. Early mobilization

Deep vein thrombosis (DVT) is a major health risk, especially in hospitalized patients with various risk factors, including smoking, hypertension, diabetes, and obesity (31). DVT continues to be a

common complication of hospitalization, despite treatment advancements. Early mobilization may be passive, assisted, or active, contingent on the patient profile and available resources³¹.

2. Oral Medications for VTE

Apixaban and rivaroxaban are frequently utilized direct oral anticoagulants for venous thromboembolism (VTE)³². Apixaban and rivaroxaban are direct oral anticoagulants (DOACs) recommended as first-line treatments for these conditions³². The classification of dosage defines low as apixaban less than 10 mg/day and rivaroxaban less than 20 mg/day, and high as apixaban 10 mg/day or greater and rivaroxaban 20 mg/day or greater³².

3. Intravenous Medications for VTE

A frequently used approach to prevent VTE in hospitalized or post-surgical patients involves administering a standard prophylactic dose of LMWH, such as enoxaparin 40 mg once daily or

30 mg twice daily³³.

Intravenous unfractionated heparin (UFH) is utilized in managing venous thromboembolism (VTE). While largely supplanted by low molecular weight heparin (LMWH), it is preferred for critically ill patients or those with renal impairment³². Raschke compared a fixed-dose regimen (5,000-unit bolus and 1,000 units/hour infusion) with a weight-based nomogram (80 units/kg bolus and 18 units/kg/hour)³³. The weight-adjusted regimen achieved therapeutic anticoagulation more rapidly and resulted in a significantly lower VTE rate³³.

CONCLUSION

Obese patients in critical condition pose distinct challenges in the ICU, influenced by altered physiology, comorbidities, and pharmacological factors. Literature evidence supports tailored airway techniques, lung-protective ventilation, individualized hemodynamic and drug dosing, targeted nutrition, and proactive thromboprophylaxis with early mobilization. A multidisciplinary,

patient-specific management plan is crucial for optimizing clinical outcomes and minimizing complications in this high-risk population.

CONFLICT OF INTEREST

The authors declare no relevant conflicts of interest regarding this article.

REFERENCE

1. Kalani C, Venigalla T, Bailey J, Udeani G, Surani S. Sepsis Patients in Critical Care Units with Obesity: Is Obesity Protective? *Cureus*. 2020 Feb 10. doi:10.7759/cureus.6929
2. Peters U, Dixon AE. The effect of obesity on lung function. 2019.
3. Thota B, Jan KM, Oh MW, Moon TS. Airway management in patients with obesity. *Saudi J Anaesth*. 2022 Jan;16(1):76–81. doi:10.4103/sja.sja_351_21
4. National Academies of Sciences E, Division H and M, Board F and N, Solutions R on O, Nicholson A. Current State of Pharmacokinetics and Pharmacology for Obesity. In: *Medications and Obesity: Exploring the Landscape and Advancing Comprehensive Care: Proceedings of a Workshop* [Internet]. National Academies Press (US); 2024 [cited 2025 Jul 16]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK609406/>
5. Ghimire P, Sankari A, Antoine MH, Bollu PC, Kaul P. Obesity-Hypoventilation Syndrome. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [cited 2025 Jul 16]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK542216/> PubMed PMID: 31194373.
6. Shariq OA, McKenzie TJ. Obesity-related hypertension: a review of pathophysiology, management, and the role of metabolic surgery. *Gland Surg*. 2020 Feb;9(1):80–93. doi:10.21037/gs.2019.12.03
7. Powell-Wiley TM, Poirier P, Burke LE, Després JP, Gordon-Larsen P, Lavie CJ, et al. Obesity and Cardiovascular Disease: A Scientific Statement From the American Heart Association. *Circulation*. 2021 May 25;143(21). doi:10.1161/cir.0000000000000973
8. Chandrasekaran P, Weiskirchen R. The Role of Obesity in Type 2

- Diabetes Mellitus—An Overview. *Int J Mol Sci.* 2024 Feb 4;25(3):1882. doi:10.3390/ijms25031882
9. Stadler JT, Lackner S, Mörkl S, Trakaki A, Scharnagl H, Borenich A, et al. Obesity Affects HDL Metabolism, Composition and Subclass Distribution. *Biomedicines.* 2021 Feb 27;9(3):242. doi:10.3390/biomedicines9030242
10. Latos M, Szymczak A, Solecki M. Intravenous access in patients with morbid obesity. *Surg Vasc Nurs.* 2024;18(2):71–4. doi:10.5114/.2024.141479
11. De Jong A, Wrigge H, Hedenstierna G, Gattinoni L, Chiumello D, Frat JP, et al. How to ventilate obese patients in the ICU. *Intensive Care Med.* 2020 Dec;46(12):2423–35. doi:10.1007/s00134-020-06286-x
12. Hasanin A, Tarek H, Mostafa MMA, Arafa A, Safina AG, Elsherbiny MH, et al. Modified-ramped position: a new position for intubation of obese females: a randomized controlled pilot study. *BMC Anesthesiol.* 2020 Dec;20(1). doi:10.1186/s12871-020-01070-2
13. Kim ST. Anesthetic management of obese and morbidly obese parturients. *Anesth Pain Med.* 2021 Oct 30;16(4):313–21. doi:10.17085/apm.21090
14. Gaszynski T, McKechnie A. Pre-oxygenation and apneic oxygenation in patients living with obesity – A review of novel techniques. *Saudi J Anaesth.* 2022 Jul;16(3):322–6. doi:10.4103/sja.sja_351_22
15. Oh C, Chung W, Hong B. A simple equation for ideal body weight. *Eur J Anaesthesiol EJA.* 2021 Jun;38(6):671. doi:10.1097/EJA.0000000000001488
16. Gouju J, Legeay S. Pharmacokinetics of obese adults: Not only an increase in weight. *Biomed Pharmacother.* 2023 Oct;166:115281. doi:10.1016/j.biopha.2023.115281
17. Bianchettin RG, Lavie CJ, Lopez-Jimenez F. Challenges in Cardiovascular Evaluation and Management of Obese Patients. *J Am Coll Cardiol.* 2023 Feb;81(5):490–504. doi:10.1016/j.jacc.2022.11.031
18. Cai A, Liu L, Zhou D, Tang S, Tadic M, Schutte AE, et al. Obesity and

- Risk of Incident Left Ventricular Hypertrophy in Community-Dwelling Populations With Hypertension: An Observational Study. *J Am Heart Assoc.* 2024 Jun 18;13(12). doi:10.1161/jaha.123.033521
19. Csige I, Ujvárosy D, Szabó Z, Lőrincz I, Paragh G, Harangi M, et al. The Impact of Obesity on the Cardiovascular System. *J Diabetes Res.* 2018 Nov 4;2018:1–12. doi:10.1155/2018/3407306
 20. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. *Intensive Care Med.* 2021 Nov;47(11):1181–247. doi:10.1007/s00134-021-06506-y
 21. Zhang Y, Wang M, Lu Z, Yang M. Effect of Fluid Resuscitation Strategies for Obese Patients with Sepsis and Septic Shock: A Systematic Review. *Intensive Care Res.* 2022 Oct 27;3(1):61–8. doi:10.1007/s44231-022-00019-y
 22. Erstad BL, Barletta JF. Drug dosing in the critically ill obese patient: a focus on medications for hemodynamic support and prophylaxis. *Crit Care.* 2021 Feb 23;25(1). doi:10.1186/s13054-021-03495-8
 23. Ynineb AR, Yumuk E, Copot D, Ayvaz B, Khoumeri B, Othman GB, et al. memory effects in obese patients using fractional and augmented. *Sci Rep.* 2025.
 24. Zhou Q, Pan S dong, Zhu L ling, Chen M, Xia P. Weight-based dosing in medication use: what should we know? *Patient Prefer Adherence.* 2016 Apr;549. doi:10.2147/ppa.s103156
 25. May M, Schindler C, Engeli S. Modern pharmacological treatment of obese patients. *Ther Adv Endocrinol Metab.* 2020.
 26. Singh B, Cusick AS, Goyal A, Patel P. ACE Inhibitors. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [cited 2025 Jul 22]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK430896/> PubMed PMID: 28613646.
 27. Giusti EM, Spatola CAM, Brunani A,

- Kumbhare D, Oral A, Ilieva E, et al. International Society of Physical and Rehabilitation Medicine/European Society of Physical and Rehabilitation Medicine Guidelines on Physical and Rehabilitation Medicine Professional Practice for Adults with Obesity and Related Comorbidities. *J Int Soc Phys Rehabil Med.* 2020;3(1):11–21. doi:10.4103/jisprm.jisprm_6_20
28. De Waele E, Jakubowski JR, Stocker R, Wischmeyer PE. Review of evolution and current status of protein requirements and provision in acute illness and critical care. *Clin Nutr.* 2021 May;40(5):2958–73. doi:10.1016/j.clnu.2020.12.032
29. Dickerson RN, Andromalos L, Brown JC, Correia MITD, Pritts W, Ridley EJ, et al. Obesity and critical care nutrition: current practice gaps and directions for future research. *Crit Care.* 2022 Sep 20;26(1). doi:10.1186/s13054-022-04148-0
30. Frenette A, Gershkovich B, Castellucci LA, Patel RV. Venous thromboembolism prophylaxis in obese, critically-ill patients: A survey of Ottawa region Intensivists. *Thromb Res.* 2020 Feb;186:42–4. doi:10.1016/j.thromres.2019.12.004
31. Raya-Benítez J, Heredia-Ciuró A, Calvache-Mateo A, Martín-Núñez J, Valenza-Peña G, López-López L, et al. Effectiveness of non-instrumental early mobilization to reduce the incidence of deep vein thrombosis in hospitalized patients: A systematic review and meta-analysis. *Int J Nurs Stud.* 2025 Jan;161:104917. doi:10.1016/j.ijnurstu.2024.104917
32. Schaefer JK, Errickson J, Kong X, Ali MA, Chipalkatti N, Haymart B, et al. A Comparison of Outcomes With Apixaban, Rivaroxaban, and Warfarin for Atrial Fibrillation and/or Venous Thromboembolism. *JACC Adv.* 2025 May;4(5):101714. doi:10.1016/j.jacadv.2025.101714
33. Sorodoc V, Asaftei A, Ceasovschih A, Lionte C, Crisan S, Constantin M, et al. Anticoagulation approach in morbid obesity: a comprehensive review on venous thromboembolism management. *Front Pharmacol.* 2024 Dec 17;15:1457280. doi:10.3389/fphar.2024.1457280