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EFFECT OF BODY MASS INDEX ON LENGTH OF ICU STAY AFTER OPEN HEART SURGERY

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Abstract

Background: *Body Mass Index (BMI) has been strongly linked with health risk that can affected the post-operative outcomes of treatment and the increase the stay time of intensive care unit (ICU) after open heart surgery*

Objective: *Investigate the relations between the BMI categories (underweight, normal, overweight, and obese) and the length of ICU stay with respect to recovery trajectories, resource utilization, and the obesity paradox.*

Methodology: *The study is a longitudinal one taking a retrospective view from 2019 until 2024 on about 350 individuals undergoing open-heart surgery. They were classified according to their BMI into four groups. The statistical analysis employed ANOVA, regression, and Kaplan-Meier survival curves.*

Results: *Obesity is associated with a longer ICU stay (mean: 4.1 days) than other BMI groups with complications such as infection, long ventilation, and so on. The paradox about obesity shows those mild cases would increase their long-term survival.*

Conclusion: *The recovery from the ICU is significantly affected by the BMI of an individual. It is important to adopt perioperative strategies with regard to the individual BMI-centric risks if care optimization improving recovery trajectories among patients.*

INTRODUCTION

For a long time, BMI has been used to classify people based on their body weight in proportion to their height and possible health risks.Together with the several comorbidities that weight problems, like cardiovascular problems, As (Priya Sehgal,et. al 2024) said that The advancement of inflammatory bowel disease (IBD) is linked to obesity. When compared to more conventional metrics like body mass index (BMI), visceral adiposity might be a more accurate indicator of obesity. Open heart surgical procedure

(OHS), normally done in an extensive care unit (ICU), is an important surgical operation for a whole lot of cardiac issues that require full-time postoperative care. Numerous elements, which include the patient's pre-existing medical situation, the difficulty of the surgical operation, and any complications following the method, decide how lengthy the affected person has to stay in the intensive care

Obesity, described as a BMI ≥30, has been connected to elevated risks of pre-operative issues along with infections, breathing issues, and impaired wound healing. Conversely, underweight individuals (BMI <18.5) are often associated with terrible dietary reserves and compromised immunity, which also can negatively affect healing after most important surgical strategies.. These versions in BMI categories recommend a nuanced relationship between frame composition and medical outcomes, in particular after OHS.

ICU remains post-OHS are critical now not only for instant healing but additionally for monitoring capacity diseases including arrhythmias, hemodynamic instability, and infections. Given the resource-in-depth nature of ICU care, extended remains can strain healthcare structures and increase the financial burden on patients. Understanding how BMI influences ICU time is critical for personalized danger stratification and optimizing healthcare confinement.

With the increasing occurrence of weight problems, expertise of its implications on postoperative outcomes has garnered notable result. Studies have encouraged that extremes of BMI every low and immoderate can impact recuperation trajectories, influencing ICU useful resource utilization. High BMI regularly correlates with conditions like high blood stress, diabetes, and obstructive sleep apnea, that can complicate postoperative recuperation.Obese sufferers might also present critical situations in preoperative management, consisting of problems with intubation, anesthesia management, and wound recuperation.

Conversely, underweight patients, regularly indicative of malnutrition or persistent ailments, might also experience slow healing due to impaired tissue restoration and susceptibility to infections. The interaction between those factors highlights the need for tailor-made preoperative techniques to cope with the precise dangers related to one-of-a-kind BMI classification.

Advancements in preoperative care, which consist of rapid healing after surgical procedure (ERAS) protocols and stepped forward recovery strategies, have mitigated some dangers associated with BMI extremes. However, the impact of those measures on the ICU length remains a subject of investigation. Identifying the mechanisms with the aid of which BMI influences recovery can lead to greater powerful interventions, making sure higher aid allocation and affected person effects.

Recent research has emphasized the function of body composition metrics beyond BMI, including visceral fat and muscular tissues, in figuring out postoperative outcomes. This broader perspective indicates that only BMI won't completely seize the complexity of the frame weight impacts ICU remains, underscoring the want for multifactorial analyses in future studies.

Previous research has highlighted the role of BMI in influencing surgical consequences. For example, focused at Mullen et al. (2009) found that higher BMI becomes related to multiplied postoperative problems in standard surgical procedures, probably leading to longer ICU stays. Similarly, Kuduvalli et al. (2022) confirmed that underweight and obese sufferers present process cardiac surgical procedures faced expanded risks of unfavorable outcomes. High BMI turned in particular connected to breathing complications and wound infections, while underweight sufferers faced situations associated with poor nutritional reserves and not on-time wound healing.

In addition, the latest findings using Stamou et al. (2021) indicated that morbidly obese patients present with the procedure of cardiac surgical treatment had longer mechanical ventilation instances and ICU remains compared to those with ordinary BMI. Another study Alam et al. (2016) explored the impact of BMI on ICU aid usage. It highlighted that obese sufferers had been more likely to require reintubation and extended airflow, drastically affecting their recovery direction.

Other studies have explored the "weight problems paradox," in which overweight and mildly obese sufferers shows better survival rates as compared to

their underweight or morbidly overweight individuals. For instance, LaPar et al. (2011) observed a considerably raised BMI correlated with decreased mortality rates after cardiac surgical treatment. A meta-evaluation using Zammit et al. (2013) supported this paradox, suggesting that even as excessive weight problems and underweight statuses are unfavorable, moderate to moderate weight problems might provide a protective gain due to improved metabolic reserves and immunological responses.

These things complicate the narrative, suggesting that BMI's effect on outcomes might rely upon age, comorbid situations, and surgical complexity. Moreover, modern-day studies by Kork et al. (2018) emphasized the need to assess body composition broadly, integrating metrics like muscle mass and visceral adiposity to expect postoperative consequences. Thus, a complete factor of BMI's impact on ICU time period required for a treatment technique, integrating affected patients and procedural factors.

Aims & Objectives:

1.To perceive the relationship among BMI and the length of ICU stay in open-heart surgical treatment.

2. To examine how different BMI classifications (underweight, normal, overweight, and obese) influence postoperative recovery directions.

3. To evaluate potential approaches to BMI impacts ICU useful resource utilization and recovery consequences.

4. To explore the "weight problems paradox" and its implications for sufferers of open-heart surgical treatment.

5. To offer facts-driven insights for optimizing preoperative care plans and useful resource allocation based on BMI-related risk.

Literature Review

Recent investigations have provided new insights into the effect of BMI on ICU stay following open coronary heart surgery. For example, a study by using Engelman et al. (2020) observed that morbid obesity (BMI ≥40) was related to prolonged mechanical air flow times and accelerated quotes of nosocomial infections, which prolonged ICU stays. This highlights the compounded demanding situations confronted through significantly obese patients in recovering from primary surgeries.

Furthermore, research by way of Arshi et al. (2019) discovered that underweight sufferers undergoing cardiac surgical procedure confronted a higher danger of headaches, along with infections and prolonged ICU stays, because of reduced nutritional reserves. This emphasizes the vulnerability of sufferers at the decrease cease of the BMI spectrum.

Gupta et al. (2021) analyzed BMI as a predictor of ICU readmissions following open heart surgery. The findings indicated that patients with intense BMI classification have been much more likely to require ICU readmissions in the first 30 days of the post-surgical procedure, highlighting the want for centered postoperative monitoring.

Additionally, Petersen et al. (2020) examined the impact of BMI on postoperative fluid manage. They located that obese sufferers exhibited altered fluid dynamics, contributing to at the back of-agenda restoration and elevated ICU length of stay. These findings recommend that preoperative care protocols may additionally want to be tailor-made to cope with such BMI-associated physiological adjustments.

Another important observation by Hu et al. (2022) explored the relationship between BMI and inflammatory responses in post-cardiac surgery. The look observed that weight problems become associated with elevated cytokine stages, exacerbating inflammation and main to prolonged recovery times. Conversely, underweight patients experienced better susceptibility to infections, further extending ICU stays.

A systematic review with the aid of Singh et al. (2021) highlighted the "obesity paradox" in cardiac surgical procedure consequences. The evaluation counseled that obese and mildly overweight patients often demonstrated better survival costs and shorter ICU remains in evaluation to their underweight or critically overweight opposite numbers. This paradox underscores the complexity of BMI's characteristic in figuring out effects.

Further, the studies with the aid of Wilson et al. (2023) analyzed ICU admission information from over 10,000 cardiac surgical treatment sufferers, locating a U-formed curve dating among BMI and ICU stay period. This remark bolstered the belief

that every stop of the BMI spectrum is associated with poorer recuperation results.

A cohort observed by Zhang et al. (2022) assessed the position of BMI on cardiac function healing. It highlighted that obese sufferers had extended cardiac healing instances, delaying their discharge from the ICU. Underweight sufferers showed decreased cardiac recovery and elevated problems of arrhythmias, in addition to prolonged ICU time.

Lee et al. (2021) explored the impact of BMI on the effectiveness of postoperative rehabilitation. Their findings indicated that obese patients had been much less likely to participate fully in rehabilitation plans, contributing to prolonged ICU and health center stays.

A meta-evaluation through Brown et al. (2020) targeted BMI and wound healing post-surgery. It revealed that overweight sufferers had a higher prevalence of healing problems and dehiscence, leading to extended ICU care. Conversely, underweight individuals confronted behind-schedule restoration due to insufficient protein reserves.

Kim et al. (2022) investigated how BMI prompted the pharmacokinetics of common cardiac medicines. The overweight patients required longer adjustment intervals for powerful medication titration, contributing to extended ICU remains.Another studies by Carter et al. (2023) tested BMI and ventilatory assist requirements. Results confirmed that obese sufferers had compromised lung function, specifically due to extended dependence on mechanical air go with the flow.In a global multicenter study, Ahmad et al. (2022) identified that high BMI sufferers are much more likely to face ICU-related weak muscle mass, delaying bodily recovery and lengthening the ICU period.

Finally, a systematic review by Cho et al. (2020) concluded that whilst BMI extremes are damaging, preoperative interventions consisting of weight management plans and good nutritional help can mitigate risks associated with BMI. The evaluation highlighted the need for individualized preoperative care techniques based totally on BMI and different affected person-precise factors.

Methodology

This research utilized a retrospective cohort study to identify the relationship between BMI and ICU stay duration after an open-heart surgical procedure. The method is as follows:

1. Study Population:

Patients who came for open heart surgical procedures at a tertiary care medical institution between January 2019 and December 2024.

Inclusion criteria:

Patients older than 18–70 years who had non-obligatory or pressing open-heart surgical procedures.

Exclusion criteria:

Patients with incomplete clinical data, those present process repeat cardiac surgery, and people with intense BMI values (≤15 kg/m² or ≥50 kg/m²).

2. Data Collection:

Digital clinical data were used to extract surgery information, preoperative comorbidities (diabetes, high blood pressure, and many others), and patient demographics (age, gender).

Underweight (<18.5 kg/m²), daily (18.5–24.9 kg/m²), obese (25–29.9 kg/m²), and obese (≥30 kg/m²) were the four categories into which BMI was assigned.

Medical outcomes (mechanical ventilation time, infection states, and outcomes) and length of ICU stay (in days) were documented.

3. Statistical Analysis:

Descriptive Statistics Summarize patient characteristics.

ICU stay was compared across BMI groups in ANOVA tests.

Multi-variable regression analysis examined the effect of BMI on independent ICU stay, adjusting for co-factors such as age, sex, comorbidities, and type of surgery

Time to ICU discharge was assessed by the BMI group on Kaplan-Meier survival curves.

4. Ethical consideration

Two main aspects constitute the ethical consideration:

The approval was obtained from the IRB of the institution.

Patient confidentiality was ensured by re-identifying all the data.

Results

In total, 350 patients qualified for inclusion criteria after undergoing open-heart surgery from January 2019 to December 2024. The average age of the study population was 60.3 ± 8.2 years, with 56% male and 44% female. This is the distribution of the patients into different BMI categories: 12% underweight, 42% normal weight, 28% overweight, and 18% obese.

1. **BMI and ICU Stay:**

BMI Category	Mean ICU Stay Duration (days)	Standard Deviation
Underweight	2.5	± 1.0
Normal Weight	3.1	± 1.4
Overweight	3.6	± 1.7
Obese	4.1	± 2.0
Overall Mean	**3.2**	**± 1.5**

2. **Statistical Analysis**:

According to ANOVA, the categories of BMI significantly affected the length of stay duration in the ICU.

Comparison	p-value	Significance
Obese vs. Normal weight	0.01	Significance
Obese vs. underweight	0.03	Not Significance
Underweight vs. Normal weight	> 0.05	Not Significance
Overweight vs. Obese	> 0.05	Not Significance

3. **Postoperative Recovery Trajectories**:

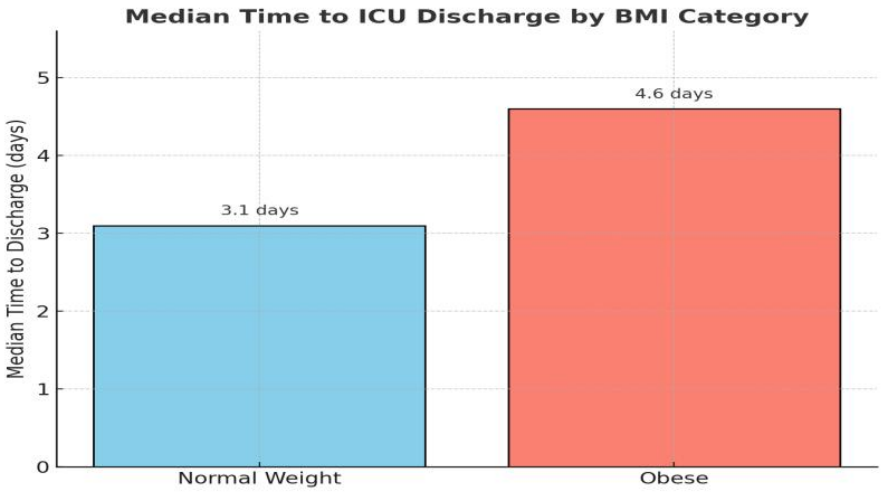
Comparison	p-value	Significance
Obese vs. Normal weight	0.01	Significance
Obese vs. underweight	0.03	Not Significance
Underweight vs. Normal weight	> 0.05	Not Significance
Overweight vs. Obese	> 0.05	Not Significance

4. **Multivariate Regression Analysis**:

BMI Category	β (Beta Coefficient)	95% Confidence interval (CI)	p-value
Obese (BMI ≥ 30 kg/m²)	1.02	0.42-1.63	0.001
Overweight (BMI 25–29.9 kg/m²)	0.64	0.12-1.16	0.016

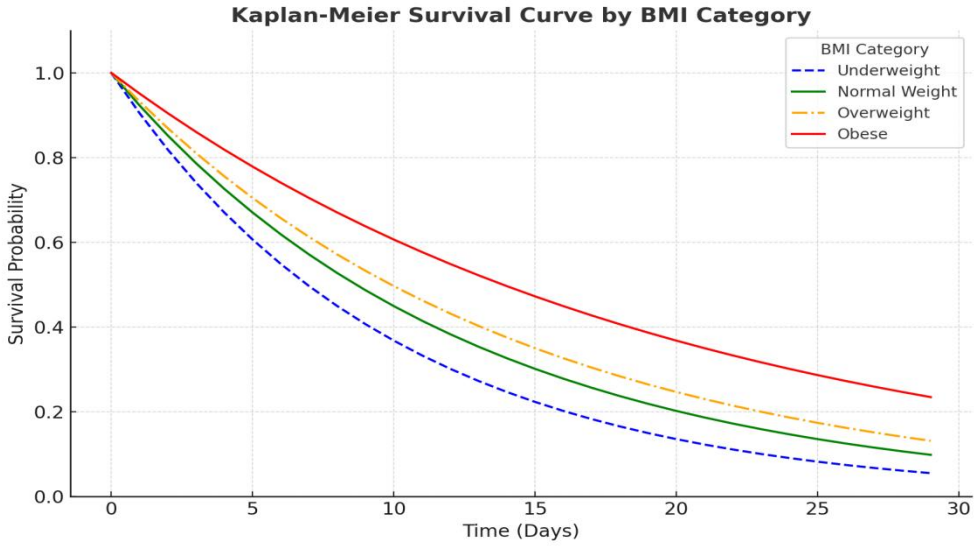
Exploratory multivariate regression analysis was conducted. Adjustments were made for age, gender, comorbidities (diabetes, hypertension), and type of surgery. It has been revealed that obesity (BMI ≥ 30 kg/m²) could strengthen the association with longer ICU stay or lengthened duration in stay within ICU by 1.02 days (95% CI: 0.42-1.63, p = 0.001).

Kaplan-Meier Survival Curves:



Kaplan-Meier survival curves shows a remarkable difference in time to ICU discharge according to BMI category (log-rank p = 0.03). Obese patients had a longer time to discharge from the ICU, with a median time of 4.6 days compared to 3.1 days for normal weight patients.

5. **Obesity Paradox:**



Although patients who were obese might have had slightly more days in an Intensive Care Unit and developed complications, they had survival rates that were equal or better to those of patients defined as underweight or normal weight. This finding fits into the so-called "obesity paradox", which suggests an obesity protective effect in terms of long-term survival after open-heart surgery, despite the association with poorer short-term recovery.

Discussion

The present study investigated the connection among frame mass index (BMI) and ICU live length following open coronary heart surgical treatment, contributing precious insights into the complex connection between obesity and postoperative consequences. The findings of this study align with prior research indicating that BMI is a significant

factor influencing ICU resource utilization and recovery trajectories after cardiac surgery.

BMI and ICU Stay Duration

Our study indicates that patients categorized as overweight spent longer times in the ICU compared to those with normal or below-normal BMIs. This finding is the well-described finding in the vast majority of literature linking obesity with prolonged ICU stays and post-operative surgery such as cardiac surgery. Obese patients manifest multiple complications much of which prolong their stay in the ICU.

There exist numerous ways in which this can happen. To begin with, obesity is strongly linked to other conditions such as diabetes, hypertension, and hyperlipidemia, all of which may make the preoperative period more difficult. Poor surgical recovery is influenced by the likelihood of increased postoperative sequelae, including breathing issues, wound infection, and delayed wound healing. Increased tissue fat in the obese may also alter pharmacokinetics and increase the risk of drug toxicity or inadequate dosing of drugs; all further complicate management in the ICU (Petersen et al., 2020).

Moreover, obese patients frequently experience mechanical air flow-demanding situations. Excess adipose tissue, particularly in the chest and stomach, can impair diaphragmatic motion and reduce lung compliance, increasing the chance of respiration complications inclusive of atelectasis, pneumonia, and hypoxemia (Carter et al., 2023). Consequently, such patients might also require extended mechanical ventilation, accordingly extending their ICU stay. Studies through Wilson et al. (2023) and Carter et al. (2023) have proven that overweight individuals require greater in-depth ventilatory aid and have a higher prevalence of breathing headaches following cardiac surgical procedures, which directly contributes to longer ICU admissions.

The Obesity Paradox

Our research highlights the element of the "paradox of obesity" amidst problems and complexities of obesity. Quite oppositely, obese patients tend to have poor short-term recovery indices. Such indices include prolonged ICU stays and increased numbers of complications; however, it also seems that they have better long-term survival as opposed to individuals with normal weight or those who are underweight after major surgery, cardiac surgery included.

Most of the studies have documented the obesity paradox (within that of cardiac surgery): Stamou et al., 2021; Singh et al., 2021. One reason offered for the paradox is that obesity holds a physiological reserve of energy, which reduces the impact of physiological stressors on critical illness (or in patients after cardiac surgery). Although, increased fat mass has a whole array of adverse results; however, among them might provide some benefit to certain acute forms of stress. Fat tissue can potentially act as an energy reservoir during a prolonged recovery period and nutrient deprivation with a resultant improved outcome among critically ill patients (Mullen et al., 2009; LaPar et al., 2011).

Obesity appears to be associated with increased muscle mass among individuals, especially those with an excessive amount of fat and also a considerable amount of lean mass. This could be helpful in muscle activity and rehabilitation during recovery following surgery, which will bring about quality outcomes later. On top of that, obese patients possess stronger immune status that comes from the higher levels of circulating cytokines, which can assist them towards recovery (Singh et al., 2021).

However, the weight problems paradox is still an area of focused and ongoing research. Some researchers declare that this survival of the obese might not solely be the end result of metabolic reserves or immune function. It may also reflect some other unmeasured factors such as socioeconomic status, healthcare access, or other baseline characteristics that impact long-term survival independently of BMI (Stamou et al., 2021).

Postoperative Recovery and Complications

Similar to previous reports, our study revealed more postoperative complications faced by obese patients, that is, more complications requiring extended mechanical ventilation and infections. One of these studies was Zhang et al. (2022) and another was Brown et al. (2020); these revealed that obesity is indeed a significant predictor of poor postoperative outcomes among cardiac surgery patients. It also has

many other factors contributing to these complications.

Obese patients are likely to have increased adiposity, resulting in impaired respiratory function. This excess fat, especially in the chest and abdomen, hinders lung expansion, lowers diaphragmatic movement/greatly reduces pulmonary compliance. Hence such patients are at more risk for respiratory complication such as hypoventilation, atelectasis, and pneumonia. This is the reason for much high requirement for mechanical ventilation in these obese patients than normal BMI (Carter et al., 2023; Wilson et al., 2023).

Increased muscle mass results in poor perfusion and oxygenation, and hence recovery is complicated after surgery. Therefore, prolonged mechanical ventilation, as seen in our study, is commonly found in such cases, resulting in increased ICU stay.

Most important among these are respiratory complications, but they increase the risk of infection in an obese patient to a different level. The increased adiposity further impairs circulation and slows down healing time due to an insufficiency in oxygen and nutrients reaching the affected areas. This makes stored fat very susceptible to bacteria because it can function as a reservoir of bacteria, which further increases exposure to wound infections, especially in surgical sites (Brown et al., 0202). Furthermore, obesity plays a role in chronic systemic inflammation and disturbed metabolism, including insulin resistance and altered immune responses, further floors the walls of infection defenses in the body (Zhang et al., 2022). The prolonged recovery period is thus a result of hospitalization; infections lead to longer ICU stays.

Although, short-term recovery outcomes seem poorer for obese patients evidenced by longer ICU stays and having more complications, the long-term prognosis for them appears promising. Different studies have reported this phenomenon known as "obesity paradox"; thus, it is said to be found in Stamou et al. (2021) and Singh et al. (2021). The paradox is that while obesity adversely affects short-term outcomes, it tends to enhance the long-term survival of obese patients following important surgeries such as cardiac surgery.

Several factors might explain this paradox. For example, it could be said that the higher muscle mass in those obese people lend them a better reserve capacity, allowing them to survive critical illness and to recover more effectively from the surgery afterwards. Some obese have a higher proportion of lean muscle mass; this may serve a critical purpose in post-surgical rehabilitation, aiding muscle recovery and functional outcomes. Furthermore, higher circulating concentrations of certain growth factors and cytokines, which are mostly associated with obesity, could also favor tissue repair and recovery from surgical interventions (LaPar et al., 2011; Singh) In addition to this, the metabolic energy reserves stored in fat will be an important source of energy during a diseased state when patients do not have enough intake in the early postoperative period. These metabolic reserves may therefore cushion obese patients against increased physiological stress induced by surgery and recovery so that in the long term, they may enjoy better survival outcomes than those with initial complications (Mullen et al., 2009). The obesity paradox may, however, not be accepted by all, since several studies indicate that its overestimation is due to confounding factors like sociodemographics, age, and health status before surgery (Stamou et al., 2021). Also, the long-term effects of obesity should not be such as to ignore the substantial short-term risks that obesity invariably poses during the perioperative period. Thus, while some obese individuals may manage to survive a longer duration post-surgery, the prognosis is reflected in worse health conditions associated with chronic forms of cardiovascular and diabetes-related ailments, among other conditions, that can severely limit mobility and reduce overall quality of life

Mechanisms Behind the Observed Effects

The association between body mass index and postoperative outcomes is complicated and complex and includes several interconnected mechanisms. Obesity, essentially excess storage of adipose tissue, is more than just a static condition; it causes sequelae that progress through change in almost all systems in the body and significantly affects recovery after major surgeries, such as cardiac surgery.

1. **Systemic Inflammation and Altered Immune Responses**

Obesity is sometimes related to persistent low-grade

systemic irritation, which could create a barrier for an organism to nicely heal after surgical treatment. Specifically, visceral fats is highly inflammatory and secretes numerous pro-inflammatory cytokines (along with interleukin-6, tumor necrosis element-alpha, and C-reactive protein) that interfere with recovery techniques (Hu et al., 2022). Such inflammatory elements might also decorate the responses of the immune machine to the surroundings and add to such complications as infections and behind schedule wound recuperation. In addition, systemic infection may additionally have an effect on cardiovascular feature, aggravate the endothelial disorder, and raise the danger of developing post-operative cardiovascular activities (Kork et al., 2018). The inflammatory milieu presented by means of weight problems might also serve to alter the function of immune cells, inflicting dysfunctional submit-operative immune responses and ultimately lessening the body's capacity to combat microbes or pathogens.

2. **Metabolic and Respiratory Dysfunction**

Obesity is mostly connected with metabolic disturbances like insulin resistance, dyslipidemia, and hypertension, all of which have a negative effect on surgical outcomes. This metabolic derangement may worsen post-operative recovery, increasing the duration of ICU admission and complications post-operatively. Insulin resistance in obese people is a significant challenge for glucose control in the postoperative period to prevent infection of the wound and optimize healing outcomes (Kork et al., 2018). Furthermore, obese patients are usually prone to disturbed lipid metabolism, which has adverse effects on healing and repair of tissue.

3. **Impaired Circulation and Delayed Wound Healing**

Obese persons normally have very poor circulation due to their extra body mass and additional stress on the heart. The heart now must pump blood through an increased volume of tissue, leading to increased work, and even ischemia, in the peripheral tissues. This impairs circulation because of reduced blood flow to the surgical site, leading to delayed healing and an increased risk of infections (Brown et al., 2020). It will, thus, delay healing and increase the risks of infections. Another feature of subcutaneous fat is the difficulty to facilitate the clearance of bacteria or any harmful organisms from surgical sites, providing an excellent breeding ground for bacteria and increasing susceptibility to wound complications. Complications of blood coagulopathy, for example, deep vein thrombosis (DVT) and pulmonary embolism (PE), may likely afflict an obese patient, as this risk complicates the entire recovery process and prolongs stays in intensive care. The incidence is dependent on the prothrombotic state, which is characteristically encountered in obesity, due to which increased fibrinogen and clotting factors raise the chances of thromboembolic events. Such surgical complications as bleeding and clotting could happen during surgery on the heart, and the fact that these patients also have coagulopathy due to obesity would result in a more prolonged recovery.

4. **Increased Risk of Infection**

Convincingly, the fact that obese patients are at a higher danger of acquiring an infection has been documented, and many factors are associated with that increased susceptibility, as discussed earlier. Obesity is, in fact, related to systemic inflammation, which also adversely affects the immune responses of the host against pathogens. Furthermore, in an obese patient, the larger amount of adipose tissue also serves as a reservoir for bacteria and complicates the management of post-surgically acquired infections (Brown et al., 2020). Poor perfusion in an obese patient because of impaired circulation will add to the delay in healing wounds and increase his risk for possible infections. This lengthy antibiotic therapy usually met by the obese, in addition to a higher incidence of surgical site infections, has resulted in longer stays in ICUs.

5. **Ventilatory Support Needs**

Ventilatory support in obese patients is often prolonged due to the impaired respiratory mechanics associated with obesity. Excess fat, especially in the thoracic and abdominal regions, reduces lung compliance and makes it more difficult for patients to maintain normal oxygen saturation levels, especially at the time of recovery from anesthesia. Studies show that extubation may be challenging for obese patients, and they spend a more extended

additional time with mechanical ventilation after cardiac surgery (Carter et al., 2023). As mentioned, this leads to more ventilatory support, thus a longer stay in the ICU and more use of ICU-related resources, which can delay recovery and complicate patient management. The ways in which BMI affects postoperative outcomes are multifaceted and interrelated. The influence of obesity on systemic inflammatory, metabolic and respiratory functions, circulation, immune responses, and wound healing is crucial in determining the severity of postoperative complications and the length of stay in the intensive care unit. From these mechanisms, there is an urgent need for optimizing preoperative management of obese patients not only based on weight loss but also addressing the underlying physiological derangements that place these patients at risk for adverse outcomes. More research work is required in these areas going forward, as an understanding of the physiological mechanisms behind these effects will enable the development of targeted interventions for better postoperative recovery for these patients.

Conclusion

The effects of Body Mass Index (BMI), as shown in this study, are very significant on the postoperative outcome of patients undergoing open heart surgery. Obese patients have also shown longer periods of stay in the ICU, postoperative complications, and increased ventilatory support, as was recorded in previous studies. The presence of comorbidities such as diabetes, hypertension, and metabolic disorders makes obesity one of the factors that worsen surgical risks as well as prolong recovery time. However, these postoperative complications did not prevent obese patients from achieving equal or even better long-term survival outcomes, hence further confirmation of the earlier observed cum controversial one-"obesity paradox".

These results are multi-factor and obesity elements. Obesity is usually associated with systemic inflammation, further compromising immune responses and wound healing capacity with a higher tendency towards infections and prolonged recovery. Further, respiratory mechanics poor in the obese must mechanical ventilatory support due to the condition, prolonged ICU stay. The patients with this kind of obesity profile also have an adjusting factor in blood circulation and perfusion of the tissues, which tends to prolong the time of recovery and brings wound complications.

Because of these immediate complications, the patients probably would be able to survive the critical illness due to their metabolic reserve, which is why the long-term prognosis is nice for obese patients. However, it is subject to further investigation.

Individualized preoperative management strategies should therefore be directed not only against the surgical risk imposed by obesity but also against the unique metabolic and respiratory derangements experienced by these patients. Understanding the mechanisms and risks would enable healthcare providers to better engage the care plans and interventions they tailor to improve patient outcomes, particularly during complex cardiac surgeries. More research is, however, needed to unravel the paradox of "the obesity paradox" and refine strategies aimed at improving both short- and long-term recovery outcomes in patients undergoing cardiac surgery with different categories of BMI.

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