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Caring for the Obese Patient: Special Considerations in the ICU

Authors

Hans Ulrich Rothen, *MD, PhD*

Ludger Mende, *MD*

Department of Intensive, Care Medicine

Bern University Hospital (Inselspital)

Bern, Switzerland

hrothen@insel.ch

In recent years, obesity has emerged as a major problem, both generally in terms of public health, and at a more personal level. Body mass index (BMI) is the ratio of weight for height, often used as a simple indicator of adiposity. A patient with a BMI of > 25 kg/m2 is termed overweight, if the BMI is > 30kg/m2 he is obese, and with a BMI > 40 kg/m 2 he is considered extremely or morbidly obese.

More than 60% of the inhabitants of the United States are overweight, with a still increasing trend in recent years. Accordingly, there was a six-fold increase over ten years in the number of bariatric surgeries in the United States, with more than 100,000 procedures in 2002. A similar trend is present in Europe, even though the overall prevalence of obesity is less than in the US. Recent studies suggest that this number is between 3% and 10%. In France, a prevalence of 12% was found for a BMI between 29 to 39 kg/m2, and 0.5% for morbidly obese adults.

The increasing number of obese patients requiring critical care represents a challenge for intensivists. They must take into account specific changes in pulmonary and haemodynamic physiology, pharmacologic considerations and problems of nursing care. Of note, obese patients may have a prolonged length of stay in the ICU. Accordingly, such patients are at risk of a disproportionate, large use of resources.

Obesity: Associated Risks

Obesity is associated with a higher overall risk of death in all ages and in all racial and ethnic groups. The risk of in-hospital mortality and postoperative morbidity is increased. Obesity itself is an independent risk factor of mortality in ICU patients. Also, obesity was found to be an independent predictor of impaired postoperative outcomes after primary coronary artery bypass graft (CABG). Further, an increased number of wound infections and of acute onset of atrial fibrillation was found after CABG. Still, other studies show opposing results.

In a high number of obese patients, an increased incidence of hypertension, arteriosclerosis, coronary heart diseases, heart failure, and obesity cardiomyopathy is present. In addition, such patients may have insulin resistance or diabetes mellitus, and very often lipo-metabolic disorders are present. Obese patients also have an increased risk of postoperative thrombosis. Despite this, obesity in itself is not a significant predictor of acute organ failure or death. However, when obesity is combined with diabetes, a strong correlation was found for acute organ failure and death after acute organ failure.

Critical Care of the Obese Patient

Pulmonary Management

Many obese patients suffer from obstructive sleep apnoea, obesity hypoventilation syndrome, and impaired gas exchange. The restrictive pattern of pulmonary function present in such patients is due to an abnormal position of the diaphragm, an increased mass of the chest wall, and an increased central blood volume. Overall, a close relationship between BMI and vital capacity (VC), total lung capacity (TLC) as well as residual lung volume (RV) is found.

For each unit increase in BMI, VC, TLC and RV decrease by about 0.5%. For functional residual capacity (FRC) and expiratory reserve volume (ERV), the changes are even more dramatic. For example, between a BMI of 20 to 30 kg/m2, FRC and ERV decrease about 3% and 5% with each unit increase in BMI. The change in FRC is even more marked in the supine position and in the anaesthetised, mechanically ventilated

subject. If FRC decreases below the volume of closing capacity, this will result in lung units that are poorly or not at all ventilated. Ultimately, such lung units will collapse and ensuing atelectasis will result in an increase of pulmonary shunt. These changes also may explain the shorter time to de-saturation during induction of anaesthesia, as observed in the morbidly obese.

Various procedures can prevent atelectasis or reopen collapsed lung tissue. For example, with an inflation of the lungs using an airway pressure of 30 – 40 cm H2O, nearly all atelectatic lungs can be re-expanded. Of note, a time constant (t) of 2.6 seconds for the exponential decrease in amount of atelectasis was found when using a sustained inflation to an airway pressure of 40 cm H2O. Thus, an inflation of the lungs to 40 cm H2O maintained for no more than 7–10 seconds may re-expand all previously collapsed lung tissue in such patients.

A stepwise increase in PEEP also has been used as a recruitment manoeuvre. Finally, manual hyperinflation of the lungs might be used for such purposes. However, any disconnection from the ventilator exposed the lung to zero end-expiratory pressure (ZEEP), thus causing renewed collapse after attempted re-expansion. After a recruitment manoeuvre, PEEP significantly reduces the rate of renewed lung collapse even if a high FIO2 is used. Finally, appropriate positioning helps to improve postoperative pulmonary function.

In many centres, fast-track recovery strategies are used to reduce the duration of ventilation and length of stay in the ICU. Of note, there may be a higher percentage of fast-track weaning failure following CABG in obese patients as compared to non–obese. Accordingly, a longer period of mechanical ventilation and a longer stay in the ICU has been observed in obese patients undergoing CABG. The use of nasal positive pressure ventilation may reduce the need for (re-) intubation and invasive mechanical ventilation. In any case, the intensivist should be aware of the possibility of difficult tracheal intubation.

Haemodynamic Management

Obese patients have an increased total blood volume and an increased cardiac output and stroke volume at rest. On the other hand, such patients have an increased left ventricular pre- and after load, resulting in dilation and hypertrophy of the left ventricle. In addition, due to chronic hypoxia and hypercapnia, there often is pulmonary arterial hypertension and right ventricular enlargement and hypertrophy. As a result, obese patients suffer from poor exercise tolerance, pulmonary congestion and are at increased risk of right- and left ventricular failure.

Interpreting haemodynamic variables in obese patients can be difficult. In general, oscillometric (non-invasive) blood pressure measurements underestimate intra-arterial blood pressure. In otherwise healthy subjects, there is an increase in cardiac output and stroke volume with increasing BMI. Using cardiac index and stroke volume index, this seeming increase is markedly attenuated. Still, the ideal method of indexing haemodynamic parameters and the appropriate interpretation of such data remains a matter of debate.

Metabolism and Nutritional Support

Obese patients have an increased basal insulin level. Accordingly, lipid mobilisation from body stores is suppressed and there is an increased breakdown of proteins to support gluconeogenesis. This, in turn, results in a loss of muscle mass.

To enhance early enteral feeding, placement of a feeding gastrostomy tube should be considered. There is some evidence that hypo-caloric enteral feeding during the stay in the ICU may be superior to iso-caloric nutritional support.

Tight glucose control decreases the risk of wound infection and the risk of myocardial infarction during periods of myocardial ischaemia. Maintaining blood glucose at or below 110 mg/dL reduces morbidity and mortality among critically ill patients in the surgical ICU. Due to differing results in other studies, a unanimously accepted standard for treatment of hyperglycaemia in critically obese patients is still lacking.

Dosing of Drugs

Most recommendations concerning appropriate dosing of drugs in obese patients are based on extrapolations from the limited information available in the literature or on personal experience. Importantly, due to variation in the apparent volume of distribution, protein binding, or elimination of a drug, and due to underlying co-morbidities, the pharmacokinetic effect of a specific drug very often cannot be predicted appropriately. Monitoring clinical endpoints such as the level of sedation will help the clinician to select an appropriate dose of a medicine. For some drugs the serum concentration should be obtained to ensure an adequate dosage. Finally, in specific situations, shorter dosage intervals may be needed.

Conclusion

To improve outcomes in critically ill obese patients, it is important to focus on measures to improve lung function. Accordingly, intensivists should:

• Recommend preoperative cessation of smoking;

• be aware of postoperative residual muscle blockage;

• use appropriate positioning (sitting or semirecumbent);

• consider lung expansion techniques if atelectasis or its consequences are a relevant clinical problem;

• be aware of a difficult re-intubation;

• consider intensive insulin therapy;

• be aware of cardiovascular risks; and

• use prophylaxis of deep vein thrombosis.

Finally, a multi-modal approach including appropriate anaesthesia and analgesia will help improve outcomes in obese patients and shorten lengths of stay.

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