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Case report

Weight loss for critical care patient to improve lung transplantation candidacy: A case report

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ABSTRACT

A 47-year-old male with morbid obesity and progressive pulmonary fibrosis was admitted to the intensive care unit (ICU) with worsening hypoxia and nocturnal ventilator dependence. Due to a significant oxygen requirement, the patient could only safely remain in an acute care setting. Unfortunately, he was not eligible for lung transplantation due to having obesity, a relative contraindication to lung transplantation due to potential for post transplantation complications and increased mortality. Therefore, we treated the patient with a modified very low calorie diet (MVLCD) to achieve weight loss. He had successful, sustained weight loss over a period of seven weeks and reached a target weight that made him eligible for transplantation. He subsequently underwent successful bilateral lung transplantation. The patient had improved metabolic parameters and no side effects attributable to the reduced calorie diet. This report shows that in patients with end stage lung disease and a poor prognosis without transplantation, inpatient weight loss is safe and may allow for potentially lifesaving lung transplantation.

1. Case description

A 47-year-old male with morbid obesity, type 2 diabetes, coronary artery disease, hypertension, obstructive sleep apnea, progressive pulmonary fibrosis, and chronic hypercapneic respiratory failure status post tracheostomy seven years prior to presentation was admitted to the ICU for worsening hypoxia at home. Due to his underlying lung disease, the patient had limited exercise tolerance and activity related energy expenditure. On admission his weight was 108.9 kilograms (kg) with a body mass index (BMI) of 37 kg/m^2. He was not eligible for lung transplantation due to his BMI.

On our initial evaluation, vital signs were: temperature 37.2 °C, heart rate 86, respiratory rate 19, blood pressure 124/76 mmHg, SpO2 90%. He required an oxymizer and non-rebreather mask in the daytime and mechanical ventilation overnight, thus his care could not safely be transitioned outside of an acute care setting. His initial respiratory support levels and biochemical parameters are show in Fig. 1.

This predicament was dire as the patient was ineligible for transplantation. In order to achieve weight loss and improve candidacy for lung transplantation, we treated the patient with a MVLCD. His resting energy expenditure was estimated at 1935 kilocalories (kcal) per day using the Mifflin-St. Jeor equation [1]. We prescribed a daily meal plan consisting of 800–1000 kcal with 1–1.2 g/kg of protein, utilizing food meals and protein shakes as meal replacements. A typical daily meal plan included: one meal of 300–400 kcal (30–40 g protein, 10–15 g fat, 10–15 g carbohydrate) and three protein shakes (protein shake: 160 kcal, 30 g protein, 3 g fat, and 4 g carbohydrate; total of three shakes: 480 kcal, 90 g protein, 9 g fat, and 12 g carbohydrate). Protein comprised 60–70% of total calories, fat 20–30% of total calories, and carbohydrate 10–15% of total calories.

Over a period of seven weeks, the patient achieved weight loss of 19 kg from admission weight, down to 90 kg and a BMI of 30 kg/m^2, as shown in Fig. 2.

Hemoglobin A1c improved from 6.8% to 6.0%. There were no significant metabolic abnormalities and mechanical ventilation requirements remained stable while the patient received the calorie restricted diet (Fig. 3).

With a BMI of 30 kg/m^2, he became eligible for transplantation evaluation and listing. He required veno-venous extracorporeal membrane oxygenation bridge and underwent successful bilateral lung

Abbreviations: ICU, Intensive care unit; MVLCD, modified very low calorie diet; kg, kilogram; BMI, body mass index; kcal, kilocalorie.

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RESPIRATORY SUPPORT:

Daytime:
O2 device: tracheostomy, oxymizer, non-rebreather mask
FiO2 (%): 100%
O2 flow rate: 10 L/min at rest, 25 L/min with ambulation
Nocturnal:
Ventilator mode: pressure control
FiO2: 100%
Rate: 12
PEEP: 7 cmH2O
Pressure control level: 10 cmH2O

LABS:

BNP: 41 pg/mL
Urea nitrogen: 24 mg/dL
Creatinine: 1.11 mg/dL
Albumin: 3.2 g/dL
Hgb A1c: 6.8%

Fig. 1. Respiratory support requirements and biochemical parameters at baseline evaluation and initiation of calorie restriction.

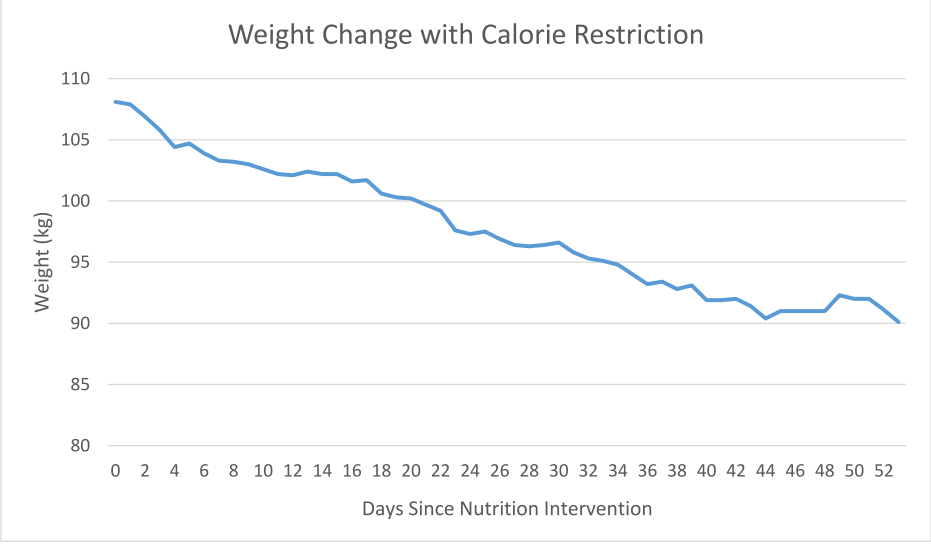

Fig. 2. Weight change (in kilograms) over time (in days) after implementation of a calorie restricted nutrition plan.

RESPIRATORY SUPPORT:

Ventilator mode: pressure control
FiO2: 90%
Rate: 20
PEEP: 15 cmH2O
Pressure control level: 15 cmH2O
Pressure support: 10 cmH2O

LABS:

BNP: 160 pg/mL
Urea nitrogen: 30 mg/dL
Creatinine: 1.00 mg/dL
Albumin: 3.0 g/dL
Hgb A1c: 6.0%

Fig. 3. Respiratory support requirements and biochemical parameters just prior to transplantation.

transplantation shortly thereafter. Most recent weight is 93 kg 1-year post transplantation.

2. Discussion

Despite an increasing number of lung transplants performed each year, waitlist mortality for lung transplantation has consistently risen over the last 10 years, and median survival following lung transplantation remains suboptimal at approximately five years [2]. Among many factors that affect post-transplantation mortality, multiple studies have shown that BMI >30 kg/m^2 reduces short-term and long-term survival after transplantation and is an independent risk factor for primary graft dysfunction, which itself is associated with increased mortality [3–6]. Though the effect of precise BMI values on post-transplantation survival is not definitively known, individual BMI units may uniquely affect post-transplantation mortality, such that each increase in BMI unit above 26 kg/m^2 confers progressively higher mortality risk after transplantation [6]. Thus, The International Society for Heart and Lung Transplantation consensus statement recommends a BMI 30–34.9 kg/m^2 as a relative contraindication and BMI $\geq$ 35 kg/m^2 as an absolute contraindication to lung transplantation [7].

A high percentage of patients with progressive lung disease have obesity due to corticosteroid use and limited exercise capacity. It has been reported that pre-transplantation weight loss is associated with decreased peri-operative morbidity and mortality, including a shorter hospital length of stay, reduced length of time on a mechanical ventilator, and improved chronic lung allograft dysfunction-free survival [8, 9].

A nutrition prescription utilizing a calorie restricted diet is a safe and effective method for weight loss, especially with close monitoring. Restriction of carbohydrate and fat content coupled with a high-protein prescription of greater than 1.0 g/kg/day has been shown to preserve

lean mass and allow for greater weight loss and fat mass loss versus a calorie restricted diet with lower protein amounts [10,11]. The safety of calorie restriction has also been demonstrated in the ICU setting. Studies show that providing optimal protein amounts (at least 1.2 g/kg/day) with a restriction of nonprotein calories does not significantly affect mortality for up to three to six months, compared with administration of total estimated caloric requirements [12]. During recovery from illness, reaching the protein goal in a critically ill patient is likely more important than nonprotein calories [13]. Given the potential for metabolic abnormalities, patients should be closely monitored, and in our patient, a continuously monitored inpatient unit provided an ideal setting. Medically supervised weight loss with a calorie restricted diet in the inpatient setting provides a unique opportunity in the management of potential transplantation patients. In those patients that may otherwise have a limited survival duration, inpatient weight loss can allow these patients to become eligible for transplantation, and, in the case of our patient, lead to successful lung transplantation.

Looking forward, it will be important to further evaluate the effect of weight loss on pre-transplant morbidity, mortality, transplant eligibility, and post-transplant outcomes in critically ill transplant candidates.

Declaration of competing interest

The authors of this manuscript have no conflicts of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.rmcr.2020.101193.

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