



BURNS IN MORBIDLY OBESE PATIENTS

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It has been estimated that 26% of Americans are obese. A very small subset of this group can be categorized as morbidly obese, fulfilling the criteria of being 100 pounds, or 100%, over ideal body weight. The clinical records of seven morbidly obese burn patients treated over a 20-year period are reviewed. Particularly notable was a 43% incidence of fatal pulmonary embolism.

OBESITY has been defined as a condition requiring a weight 20% above ideal body weight. A small subset of the obese population satisfies the requirements for the term "morbidly obese": these patients are at least 45.5 kg (100 lb), or more than 100%, above ideal body weight.¹ The obese population suffers from an increased rate of morbidity and mortality with a number of conditions including diabetes, hypertension, coronary artery disease, cerebrovascular disease, malignancies, hepatobiliary disease, osteoarthritis, and thromboembolism.² These risks are all magnified in morbidly obese persons. In an effort to define the morbidity associated with burn injury in this subset of patients, we reviewed the experience over 20 years at our institution with such patients.

METHODS

During the 20-year period 1970-1990, there were 4995 patients admitted to the United States Army Institute of Surgical Research, seven of whom clearly fulfilled the criteria for morbid obesity. The clinical records of these patients were reviewed in detail. A number of other patients were excluded from consideration because of inadequate or conflicting documentation of height or preburn weight.

RESULTS

The seven patients ranged in age from 28 to 61 years, with an average age of 47.1 years (Table 1). Four were men and three were women. Weights ranged from 134.6 kg (296 lb) to 208.9 kg (459.6 lb). The average weight was 153.1 kg (336.8 lb). Height ranged from 163 cm (5 ft 3 1/2 in) to 183 cm (5 ft 11 1/2 in), with an average height of 175 cm (5 ft 8 3/4 in). Burn size ranged from 10% to 75.5% total body surface area, with an average burn size of 38.8% TBSA. Full-thickness burn ranged from 1% to 43% TBSA, with an average full-thickness burn of 16.7% TBSA. The mechanism of injury was work related in

three patients and house or mobile home fire related in four. In at least two patients in the latter category, their extreme size or difficulty with ambulation made it impossible for them to extricate themselves from the burning structure.

Two patients sustained inhalation injury. Two patients developed pneumonia, one with inhalation injury and one without. Three patients required prolonged ventilatory assistance: two of these three patients had suffered inhalation injuries. One patient who had premorbid Pickwickian syndrome still required mechanical ventilation when discharged after closure of all wounds. Glycosuria requiring insulin administration was required in two patients.

In this group of seven patients there were two cases of wound cellulitis. There was one *Candida* wound infection and one *Aspergillus* wound infection. Two patients developed pneumonia and two developed tracheobronchitis. There were one urinary tract infection and one episode of sinusitis. Two patients had documented bacteremias.

Pulmonary emboli were quite common, with four of the seven patients suffering from this complication (57%). In three patients, the diagnosis of pulmonary embolism was made on the basis of clinical and laboratory findings, and confirmed by autopsy. In one patient, the diagnosis was based on clinical, laboratory, and hemodynamic criteria. This patient survived, and was treated with long-term anticoagulation. This 57% rate of pulmonary embolism (0.99 CI, 11.8%-94.5%) significantly exceeds the reported rate of less than 2% in the general burn population ($p < 0.01$). Heparin prophylaxis was used in three patients. This consisted of intravenous or subcutaneous administration of subtherapeutic doses of heparin. Two of the patients so treated suffered fatal pulmonary emboli.

Four (57%) of these seven patients died during their hospital stay, compared with an expected mortality rate of three of seven (43%) based on age, burn size, and the presence of inhalation injury. This difference was not significant. Three patients died of pulmonary embolism (confirmed at autopsy). One patient died of progressive

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Table 1
Morbidly obese patients, 1970-1990, demographics and outcome

Patient No.	1	2	3	4	5	6	7
Age (years)/gender	57/M	28/M	34/F	46/F	51/M	61/M	53/F
Year of admission	72	75	81	82	83	88	90
Height (m)	180.3	175.3	173	167.6	182.9	183	163
Weight (kg)	136	138	150	148.6	134.6	155.6	208.9
Ideal body wt (kg)	84	79	74	70	86	86	69
% TBSA burn (total/3rd deg.)	10/1	75.5/43	56.5/7	61/22	26/6.25	12.5/12.5	30/25
Mechanism of injury	Kerosene fire	Paint shop fire	Trailer fire	House fire	Trash fire	House fire	House fire
Inhalation injury	No	No	No	No	No	Yes	Yes
Pneumonia	No	No	Yes	No	No	Yes	No
Prolonged ventilatory support	No	No	Yes	No	No	Yes	Yes
Hyperglycemia requiring insulin	No	No	No	Yes	No	No	Yes
Myocardial infarction	No	No	Yes	No	No	No	No
DVT prophylaxis	No	No	No	Yes	Yes	No	Yes
PE	No	Yes	No	Yes	No	Yes	Yes
MI or PE diagnostic criteria	N/A	Clinical: tachypnea, cyanosis, cardiac arrest autopsy: PE	Clinical: progressive cardiovascular collapse, EKG changes autopsy: no finding	Clinical: progressive respiratory failure autopsy: PE	N/A	Clinical: hypoxia, hypotension, increased filling pressures, decreased cardiac output	Clinical: cardiac arrest autopsy: PE
Other major complications	Wound cellulitis	Leukopenia, pseudomonas sepsis, anuria	Renal failure (with dialysis), pulmonary edema, providencia sepsis, tracheobronchitis	Junctional bradycardia (with pacemaker placement)	Urinary tract infection	Wound cellulitis, candida wound infection, sinusitis, suppurative ventricular arrhythmias, pickwickian syndrome	Poor wound healing, asymptomatic tracheoesophageal fistula (autopsy finding)
Outcome	Survived	Died	Died	Died	Survived	Survived	Died
PBD at death	N/A	3	67	6	N/A	N/A	28

N/A-Not applicable.

cardiovascular collapse in association with renal failure and pulmonary sepsis. This patient had electrocardiographic (ECG) findings consistent with an acute myocardial infarction at the time of her demise. The extent of burn in the nonsurviving group was 55.6% TBSA, and the average burn size of the surviving group was 16.2% TBSA. The average time to demise of the four nonsurviving patients was 26 days, with a range of 3 to 67 days.

DISCUSSION

Morbidly obese patients present difficult logistic problems. They often do not fit in standard beds, and special beds are frequently required. Weighing these patients is often difficult, and may require the use of special scales. Wound care, physical therapy, and mobilization are all complicated by the extreme weight of these patients. Problems are also encountered in transporting patients to the operating room and in positioning and stabilizing them before and during surgical procedures. Our most recent morbidly obese patient was too large for a standard operating table and was transported to the operating room on an extra-wide, padded backboard secured to a gurney, which was also used as a makeshift operating table (Fig. 1).

Pulmonary function in morbidly obese patients is impaired by both the weight of the chest wall and decreased diaphragmatic excursion. Compounding factors include decreased hypercapnic and hypoxic response, decreased lung volumes, subclinical upper airway obstruction, and pulmonary hypertension.³ Cardiac reserve in morbidly obese patients is limited because of the large size of the vascular beds, which require correspondingly high cardiac output. The perfusion of adipose tissue requires 2–3 mL/min/kg of cardiac output, with a resulting decrease

in cardiac reserve.⁴ Morbidly obese patients are known to have a higher rate of myocardial infarction. One patient in our group suffered a myocardial infarction documented by ECG changes, although it was not clear that this was the cause of death.

Morbidly obese patients are also commonly known to demonstrate insulin resistance with hyperglycemia, despite high circulating levels of insulin.⁵ Two of our seven patients required insulin administration for control of blood sugar.

Six of seven patients suffered some type of infectious complication. This incidence of infection did not seem excessive, given the group's average burn size (38.8% TBSA with full-thickness burn size 16.7% TBSA).

The most significant finding in this review was the unusually high rate of pulmonary embolism. Three (43%) of our seven morbidly obese patients suffered a fatal pulmonary embolus as diagnosed by clinical, laboratory, and autopsy criteria. An additional patient suffered a nonfatal pulmonary embolus as documented by clinical, laboratory, and hemodynamic criteria. Thus the overall pulmonary embolism rate was 57%. In the general burn population, a 0.4% incidence of pulmonary embolism, with no fatalities, has been reported.⁶ Even in burn patients weighing more than 100 kg, an incidence of pulmonary embolism of only 1.6% was observed.⁷ The pulmonary embolism rate, however, was not correlated with patient weight. Obese patients undergoing elective abdominal procedures have also been shown to have low rates of pulmonary embolism.^{8,9} The frequent occurrence of pulmonary embolism, despite the use of standard heparin prophylaxis in 50% of those suffering a pulmonary embolus, is a notable finding in our review. Although it is difficult to make recommendations based on such a small patient group, the prophylactic use of intravenous heparin at therapeutic doses or the placement of a vena caval filter may be justified in burned morbidly obese patients.



Figure 1. A morbidly obese patient has been placed on an extra wide, padded backboard secured to a gurney. The patient was transported to the operating room, and surgery performed on the patient upon this device, the patient being too large for the standard operating table.

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