Egyptian Journal of Anaesthesia (2013) 29, 195–201

Egyptian Society of Anesthesiologists

Egyptian Journal of Anaesthesia

www.elsevier.com/locate/egja
www.sciencedirect.com

Research Article

Obesity deleteriously affects anesthetic and surgical outcome in body mass index-dependent fashion

Wael Ahmed Ibrahim [a,*], Ahmed Abdalla Mohamed [b]

[a] *NCI, Cairo University, Egypt*
[b] *Kasr Eleiny Hospital, Cairo University, Egypt*

Received 1 January 2013; accepted 6 February 2013
Available online 27 March 2013

KEYWORDS

Obesity;
Remifentanil;
Sevoflurane;
Recovery times;
Surgical outcome

Abstract *Objectives:* To evaluate obesity effect on anesthetic and surgical outcome of patients of varying BMI assigned for open abdominal surgery.
Patients and methods: Sixty patients were categorized according to WHO classification of obesity into three classes: class I (n = 30), class II (n = 18) and class III (n = 12). All patients underwent open laparotomy under combined anesthesia using continuous remifentanil infusion and balanced sevoflurane anesthesia. Hemodynamic variables, duration of surgery, intraoperative bleeding, frequency of blood transfusion, recovery times and intraoperative anesthetic or surgical problems were recorded. The occurrence of postoperative complications, admission to ICU, duration till 1st ambulation, 1st oral intake, hospital stay period and rates of morbidity and mortality were recorded.
Results: Induction of anesthesia significantly decreased arterial pressures and heart rate compared both to preoperative and pre-induction measures. After extubation all parameters returned to preoperative levels. Mean operative time was significantly longer and mean intraoperative blood loss was significantly more in patients of class III compared to those of class I and II. All recovery times showed BMI dependence as all were significantly prolonged in class II and III patients compared to class I patients with significantly shorter awakening and extubation times in class II patients than class III patients. Mean time till 1st walk was significantly longer in class III patients than class I and II patients, but time till 1st oral intake was non-significantly different. Sixteen patients developed PO complications. Mean PO hospital stay was significantly longer in class III patients compared to class I and II patients with significantly shorter duration in class II patients than those of class III.

* Corresponding author. Tel.: +20 1222857972.
E-mail address: waelahmed60@yahoo.com (W. Ahmed Ibrahim).

Peer review under responsibility of Egyptian Society of Anesthesiologists.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.egja.2013.02.001

Conclusion: Obesity caused deleterious anesthetic and surgical effects with prolonged operative and recovery times and more need for blood transfusion, ICU admission and prolonged hospital stay duration. The used anesthetic regimen allowed controlled hypotension without compromising patients' general condition.

1. Introduction

Obesity is a condition of excessive body fat, an individual must be considered obese when the amount of fat tissue is increased to such an extent that physical and mental health are affected and life expectancy reduced [1]. Obesity is a multisystem chronic pro-inflammatory disorder associated with increased morbidity and mortality. Adipocytes are far more than storage vessels for lipids. They secrete a large number of physiologically active substances that lead to inflammation, vascular and cardiac remodeling, airway inflammation, and altered microvascular flow patterns [2].

Body mass is an important determinant of respiratory function before and during anesthesia not only in morbidly but also in moderately obese patients. These can manifest as reduced lung volume with increased atelectasis; derangements in respiratory system, lung and chest wall compliance and increased resistance; and moderate to severe hypoxaemia. These physiological alterations are more marked in obese patients with hypercapnic syndrome or obstructive sleep apnoea syndrome [3,4].

Anesthesiologists should be familiar not just with screening tools for obstructive sleep apnea but also with obesity hypoventilation syndrome, which is less well appreciated and carries a significant outcome disadvantage. Perioperative management is challenging. It is centered around cardiorespiratory and metabolic optimization, minimizing adverse effects of both pain and systemic opioids, effective use of regional anesthesia, and an emphasis on mobilization and nutrition [5].

The current prospective study aimed to evaluate the impact of obesity on anesthetic and surgical outcome of patients of varying body mass index assigned for open abdominal surgery.

2. Patients and methods

The current study was conducted at Departments of Anesthesia and General Surgery, Kasr El-Eniy University hospital since June 2010 till August 2011. After approval of study protocol by the Local Ethical Committee and obtaining written fully informed patients' consent, 60 patients with BMI $\geqslant 30\ kg/m^2$ and assigned to undergo open major abdominal surgeries were enrolled in the study.

Preoperative evaluation included clinical examination for risk assessment, investigations and adjustment of associated co-morbidities. All patients with medical diseases were continued postoperatively on the same lines of treatment applied preoperatively. All patients underwent determination of body weight and height and calculation of body mass index according to the equation: $BMI = Wt\ (kg)/(Height\ in\ meter)^2$ [6]. Patients were categorized according to the World Health Organization [7] classification of obesity into: class I for a BMI between 30 and 34.9 kg/m^2, class II for a BMI between 35 and 39.9 kg/m^2, and class III for a BMI $\geqslant 40\ kg/m^2$.

The same anesthetic technique was applied for all patients. Before induction, patients were pre-oxygenated and baseline arterial blood pressures, heart rate (HR), respiratory rate (RR) and arterial O_2 saturation ($PsaO_2$) were non-invasively recorded and continuously monitored throughout theater time. Anesthesia was induced with a bolus, in 120 s, of remifentanil in a dose of 1 μg/kg, followed by propofol 1.5 mg/kg and cis-atracurium 0.15 mg/kg to facilitate orotracheal intubation. General anesthesia was maintained by balanced anesthesia of 14 μg/kg/h remifentanil intravenous infusion and 1.24% end-tidal sevoflurane in oxygen and air. Ventilation was controlled and minute ventilation was adjusted to maintain end tidal CO2 at 35 ± 5 mmHg. Intraoperative neuromuscular block was produced with cis-atracurium. At the end of surgery, atropine sulfate 0.02 mg/kg and neostigmine 0.04 mg/kg were administered I.V for reversal of muscle relaxation and the patient was extubated. Following extubation, patients were maintained on supplemental O_2 until being awake in the recovery room. Duration of surgery and occurrence of intraoperative anesthetic or surgical problems were recorded.

Major haemorrhage was defined as calculated blood loss of >1000 cc based on the difference between the preoperative and postoperative packed cell volume (PCV), and was calculated as follows: estimated blood volume × (preoperative PCV − postoperative PCV)/preoperative PCV and estimated blood volume = booking weight (kg) × 85 [8].

Emergence times to awakening, i.e., opening eyes on verbal command and orientation, i.e., correctly telling date, place, and person were determined at 1-min intervals after discontinuation of the maintenance anesthetics. Times from discontinuation of anesthesia until the patient was transferred to the post-anesthesia care unit (PACU) and PACU times were also recorded.

The occurrence of postoperative complications, postoperative admission to ICU based upon concomitant diseases and surgical requirements, the duration till first ambulation, first oral intake and length of postoperative hospital stay and rates of morbidity and mortality were recorded.

3. Results

The study included 60 patients; 23 males and 37 females with mean age of 38.5 ± 5.8; range: 26–48 years. There was non-significant ($p > 0.05$) difference between patients categorized according to BMI as regards age and gender distribution. Thirty patients (50%) were class I with mean BMI of $33.2 \pm 1\ kg/m^2$, 18 patients (30%) were class II with mean BMI of $38.8 \pm 0.8\ kg/m^2$ and 12 patients (20%) were class III with mean BMI of $43.4 \pm 2.2\ kg/m^2$. Only 14 patients (23.3%) were free of associated co-morbidities, while 46 patients (76.7%) had multiple co-morbidities in varied distribution. Patients of class I had significantly lower frequency of

Table 1 Patients' enrollment data.

	Total	Class I	Class II	Class III
Number	60	30 (50%)	18 (30%)	12 (20%)
Age (years)	38.5 ± 5.8 (26–48)	38.6 ± 6.3 (26–48)	38 ± 6.3 (27–47)	39 ± 6.3 (27–47)
Gender				
Males	23 (38.3%)	13 (43.3%)	7 (38.9%)	3 (25%)
Females	37 (61.7%)	17 (56.7%)	11 (61.1%)	9 (75%)
Anthropometric data				
Weight (kg)	100.4 ± 10.1 (87–120)	92.7 ± 4.6 (87–107)	104.5 ± 7.3 (94–115)	113.3 ± 6.4 (103–120)
Height (cm)	165.2 ± 5.3 (155–178)	167.2 ± 4.2 (161–178)	164 ± 5.3 (155–171)	161.8 ± 6 (155–170)
BMI (kg/m^2)	36.9 ± 4.3 (30.8–47.5)	33.2 ± 1 (30.8–34.9)	38.8 ± 0.8 (37.2–39.8)	43.4 ± 2.2 (40.5–47.5)
Associated co-morbidities				
No	14 (23.3%)	10 (33.3%)	3 (16.7%)*	1 (8.3%)*,†
Diabetes	17 (25%)	8 (26.6%)	5 (27.8%)	4 (33.3%)
Hypertension	13 (20%)	5 (16.7%)	5 (27.8%)	3 (25%)
COPD	9 (12.5%)	5 (16.7%)	2 (11%)	2 (16.7%)
Asthma	7 (10%)	2 (6.7%)	3 (16.7%)	2 (16.7%)
Indications of surgery				
AAW hernias	14 (23.4%)	7 (23.3%)	5 (27.8%)	2 (16.7%)
Open cholecystectomy	8 (13.3%)	4 (13.3%)	2 (11%)	2 (16.7%)
Hysterectomy	5 (8.3%)	2 (6.7%)	1 (5.6%)	2 (16.7%)
Gastrectomy and bypass	11 (18.4%)	6 (20%)	3 (16.7%)	2 (16.7%)
Incisional hernia	8 (13.3%)	4 (13.3%)	3 (16.7%)	1 (8.3%)
Gastric sleeve	8 (13.3%)	4 (13.3%)	2 (11%)	2 (16.7%)
Colectomy	4 (6.7%)	2 (6.7%)	1 (5.6%)	1 (8.3%)
Exploration CBD	2 (3.3%)	1 (3.3%)	1 (5.6%)	0

Data are presented as mean ± SD and numbers; ranges and percentages are in parenthesis, BMI: body mass index, COPD: chronic obstructive pulmonary disease, AAW: anterior abdominal wall, CBD: common bile duct,
* Significant versus class I,
† Significant versus class II.

Table 2 Hemodynamic changes occurred in studied patients throughout the duration of the procedure.

	HR (beat/min)	SAP (mmHg)	DAP (mmHg)	MAP (mmHg)
Preoperative	79.6 ± 4.2	119.2 ± 3.3	82.5 ± 5.1	94.7 ± 3.5
Before induction	80.7 ± 4.3	118.6 ± 2.8	81.9 ± 2.8	94.1 ± 3.1
After induction	72.8 ± 3.9*	104.7 ± 5*	79.4 ± 2.6*	87.8 ± 2.2*
After extubation	81 ± 4.3	116.5 ± 4.1	81.1 ± 3.8	92.9 ± 3.4

Data are presented as mean ± SD, HR: heart rate, SAP: systolic arterial pressure, DAP: diastolic artery pressure, MAP: mean arterial pressure,
* Significant difference versus preoperative measures.

co-morbidities compared to those of class II (X^2 = 5.454, $p < 0.05$) and class III (X^2 = 7.781, $p < 0.05$) with non-significantly higher frequency of co-morbidities among patients of class III compared to those of class II (X^2 = 1.821, $p > 0.05$). Twenty-two patients (36.7%) had hernias, 19 patients (31.7%) were assigned for bariatric surgeries and the remaining patients (31.6%) had varied surgical indications for laparotomy (Table 1).

All patients showed non-significant ($p > 0.05$) difference of hemodynamic measures estimated as baseline or before induction of anesthesia. Induction of anesthesia significantly ($p < 0.05$) decreased arterial pressures and HR compared both to preoperative and pre-induction measures. However, after extubation all parameters returned to preoperative levels, (Table 2).

Mean operative time was significantly longer in patients of class III compared to those of class I and II with non-significantly longer duration of surgery in patients of class II compared to those of class I. Moreover, calculated intraoperative blood loss was significantly less in patients of class I compared to other classes with non-significantly more blood loss in patients of class III compared to those of class II. Consequently, more patients in class III (66.7%) required blood transfusion compared to both class I (26.7%) and II (50%) with significantly higher number of patients required blood transfusion in class II compared to patients of class I. However, number of transfused bags showed non-significant difference among studied patients, but in favor of class I (Table 3 and Fig. 1).

All recovery times showed BMI-dependence as all were significantly prolonged in patients of class II and III compared to those of class I. Moreover, awakening and extubation times were significantly shorter, but PACU arrival and orientation times were non-significantly shorter in patients

Table 3 Operative data.

	Class I	Class II	Class III	Statistical significance
Operative time (min)	116.5 ± 20.9 (90–160)	119.7 ± 19.6 (100–180)	149.2 ± 30 (110–210)	$Z = 1.063$, $p_1 > 0.05$ $Z = 2.161$, $p_2 = 0.031$ $Z = 2.125$, $p_3 = 0.034$
Intraoperative blood loss (ml)	474.9 ± 95.3 (332–753)	518.9 ± 86.2 (406–730)	597 ± 90.1 (494–751)	$Z = 2.275$, $p_1 = 0.023$ $Z = 3.237$, $p_2 = 0.001$ $Z = 1.883$, $p_3 > 0.05$
Blood transfusion data				
Number required	8 (26.7%)	9 (50%)	8 (66.7%)	$X^2 = 6.306$, $p_1 = 0.016$ $X^2 = 17{,}216$, $p_2 = 0.005$ $X^2 = 3.061$, $p_3 = 0.043$
Number of units	1.3 ± 0.5 (1–2)	1.4 ± 0.5 (1–2)	1.6 ± 0.7 (1–3)	$Z = 0.414$, $p_1 > 0.05$ $Z = 1.134$, $p_2 > 0.05$ $Z = 0.577$, $p_3 > 0.05$

Data are presented as mean ± SD and numbers; ranges and percentages are in parenthesis, $p > 0.05$: non-significant difference, p_1: significance difference between class I and II, p_2: significance between class I and III, p_3: significance between class II and III.

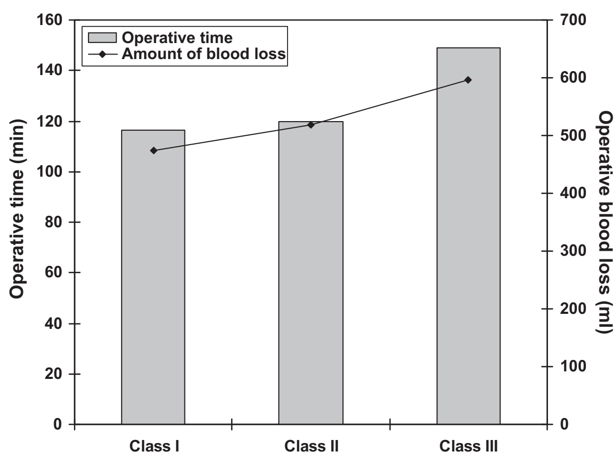

Figure 1 Mean operative time and blood loss.

of class II compared to class III patients (Table 4 and Fig. 2).

All patients passed their 1st PO day at ICU and were discharged on the 2nd morning. During ICU stay, all patients were maintained on IV fluid therapy and 23 patients (38.3%) complained of PONV of which 11 patients (47.8%) requested for antiemetics. Mean time till 1st walk was significantly longer in patients of class III compared to those of class I and II with non-significantly shorter time in patients of class I compared to patients of class II. Moreover, the frequency of patients who could walk within 1st 6-h PO was significantly higher in class I compared to those of other classes with non-significant difference in favor of class II. The frequency of patients who could take their 1st oral intake with 24-h PO was significantly higher in class I and II compared to those of class III with non-significant difference between class I and II, but in favor of class I. However, mean time till 1st oral intake was non-significantly different between studied classes but was in favor of class II (Table 5 and Fig. 3).

Sixteen patients (26.7%) developed postoperative complications; wound infection was the commonest and was reported in 11 patients (18.3%) of them 6 were diabetics and required intensive insulin therapy for control of diabetes and antibiotic and anti-inflammatory therapy with frequent wound dressing. Two patients required operative wound drainage and this prolonged their hospital stay for 17 and 19 days, respectively. Three patients had preoperative COPD and those patients developed respiratory distress and one of them required ICU admission and mechanical ventilation for 3 days but weaned successfully without distress. Three patients developed status asthmaticus and required intensive treatment for attack control till resolution. One patient developed deep venous thrombosis that assured by Doppler examination and were managed conservatively till complete resolution without getting more complications. One diabetic patient developed hyperglycemic hyperosomlar coma and required intensive insulin therapy and fluid replacement and responded well without sequale. Unfortunately, one patient had acute myocardial infarction that failed to respond to conservative treatment and died in ICU on the 7th postoperative day.

Mean postoperative hospital stay was significantly longer in patients of class III compared to patients of class I ($Z = 2.956$, $p = 0.003$) and II ($Z = 2.311$, $p = 0.021$) with significantly ($Z = 2.616$, $p = 0.009$) shorter duration of postoperative hospital stay in patients of class II compared to those of class III (Fig. 4).

4. Discussion

The present selective study was designed to include only patients with BMI $\geqslant 30$ kg/m^2 depending on the previous data that morbidity and mortality rise sharply when the BMI is > 30 kg/m^2 [9], however, the current study did not confront grave problems leading to occurrence of mortalities, this could be attributed to meticulous patients' selection and preoperative adjustment of associated co-morbidities and extended post-anesthetic care without reliance on ward care physicians. In support of the possibility of sparing immediate complications causing mortalities, Demir et al. [10] found that obesity does not increase short-term mortality for open heart surgery; however, it increases the risk of postoperative pulmonary and gastrointestinal complications and discharge with morbidity which is significantly frequent with increasing BMI.

Table 4 Mean recovery times recorded for studied patients categorized according to BMI.

	Class I	Class II	Class III	Statistical significance
Awakening time (min)	5.5 ± 1.3 (4–8)	7.1 ± 1.3 (5–9)	7.8 ± 1 (6–9)	$Z = 2.956$, $p_1 = 0.003$ $Z = 2.966$, $p_2 = 0.003$ $Z = 2.355$, $p_3 = 0.019$
Extubation time (min)	6.7 ± 0.8 (6–9)	8.1 ± 1.5 (6–11)	9.5 ± 2 (7–12)	$Z = 2.857$, $p_1 = 0.004$ $Z = 3.075$, $p_2 = 0.002$ $Z = 2.716$, $p_3 = 0.007$
PACU arrival time (min)	12 ± 0.9 (10–14)	14 ± 1.8 (11–17)	15 ± 2 (12–18)	$Z = 2.726$, $p_1 = 0.006$ $Z = 2.974$, $p_2 = 0.003$ $Z = 1.479$, $p_3 > 0.05$
Orientation time (min)	13 ± 1.3 (11–16)	16 ± 1.7 (13–19)	17 ± 2.6 (13–20)	$Z = 3.421$, $p_1 = 0.001$ $Z = 2.764$, $p_2 = 0.006$ $Z = 1.266$, $p_3 > 0.05$

Data are presented as mean ± SD; ranges are in parenthesis, $p > 0.05$: non-significant difference, p_1: significance difference between class I and II, p_2: significance between class I and III, p_3: significance between class II and III,

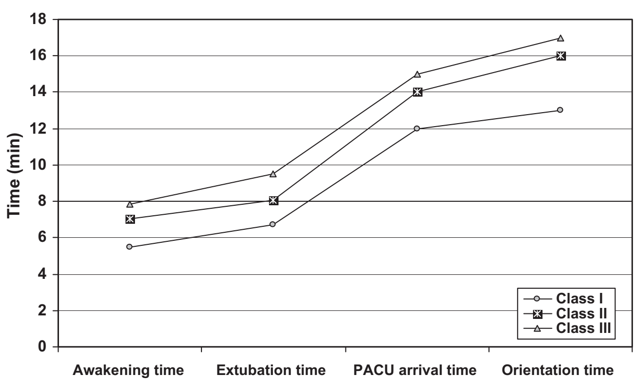

Figure 2 Mean recovery times of patient of the three classes.

The provided anesthetic procedure depended on induction of anesthesia using a bolus of remifentanil and maintenance of anesthesia using continuous remifentanil infusion at rate of 14 μg/kg/h and balanced sevoflurane anesthesia at 1.24% end-tidal volume. Such anesthetic procedure was previously documented by van Delden et al. [11] as the best combination that achieved the optimal balance between the quality, and recovery from anesthesia and by Paventi et al. [12] who reported that remifentanil infusion facilitates awakening times from balanced anesthesia with sevoflurane in obese patients, submitted to laparoscopic cholecystectomy.

The reported hypotensive effect of induction and maintenance of anesthesia depending on remifentanil significantly decreased arterial pressures and HR compared both to preoperative and pre-induction measures, which allowed control on operative bleeding, but the decrease did not compromise tissue perfusions or lead to episodes of desaturation. Short duration of action of both remifentanil and sevoflurane allowed return of all parameters to preoperative levels and provided easy and rapid recovery despite the finding that all recovery times showed BMI-dependence as all were significantly prolonged in patients of class II and III compared to those of class I with significantly shorter awakening and extubation times in patients of class II compared in patients of class III patients.

Table 5 Postoperative data.

Data	Class I	Class II	Class III	Statistical significance
Time till 1st walk (hours)				
Frequency				
< 6 h	10 (33.3%)	3 (16.7%)	2 (16.7%)	$X^2 = 6.231$, $p_1 = 0.013$
6–12 h	16 (56.7)	14 (77.7%)	9 (75%)	$X^2 = 3.695$, $p_2 = 0.039$
> 12 h	3 (10%)	1 (5.6%)	1 (8.3%)	$X^2 = 0.475$, $p_3 > 0.05$
Mean	7.6 ± 3.5(4–16)	8.5 ± 2.9(4–15)	9.5 ± 2.5(6–15)	$Z = 1.236$, $p_1 > 0.05$ $Z = 3.095$, $p_2 = 0.002$ $Z = 0.775$, $p_3 = 0.019$
Time till 1st oral intake (hours)				
Frequency				
⩽24 h	18 (60%)	9 (50%)	4 (33.3%)	$X^2 = 7.656$, $p_1 = 0.010$
> 24–36 h	10 (33.3%)	6 (33.3%)	7 (58.4%)	$X^2 = 7.183$, $p_2 = 0.01$
> 36 h	2 (6.7%)	3 (16.7%)	1 (8.3%)	$X^2 = 1.183$, $p_3 > 0.05$
Mean	24.2 ± 9.9 (12–48)	27.7 ± 10.2 (16–48)	28 ± 9.2 (15–48)	$Z = 1.092$, $p_1 > 0.05$ $Z = 1.512$, $p_2 > 0.05$ $Z = 0.306$, $p_3 > 0.05$

Data are presented as mean ± SD and numbers; ranges and percentages are in parenthesis, $p > 0.05$: non-significant difference, p_1: significance difference between class I and II, p_2: significance between class I and III, p_3: significance between class II and III.

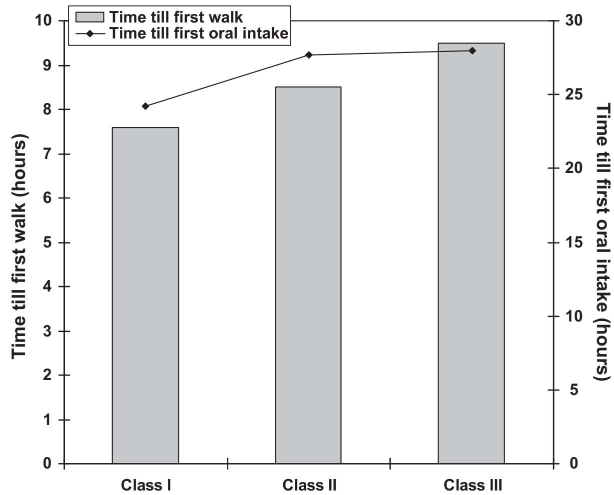

Figure 3 Mean time till first walk and oral intake.

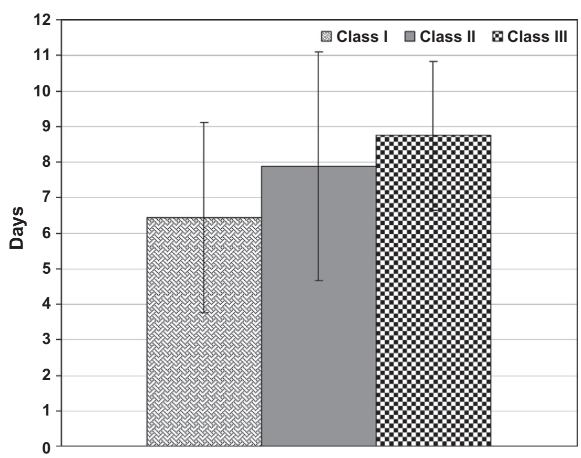

Figure 4 Mean (± SD) postoperative hospital stay.

In line with the appropriateness of the applied anesthetic regimen for such patients' population; Bidgoli et al. [13] compared effects of sufentanil and remifentanil on the quality of recovery in morbidly obese patients undergoing laparoscopic gastroplasty and found that with remifentanil time to extubation was significantly shorter and quality of recovery and duration of post-anesthesia care unit stay were comparable with statistical difference between groups. Also, Niwa et al. [14] using similar protocol of remifentanil, propofol and rocuronium for induction and anesthesia was maintained with sevoflurane and remifentanil for anesthetizing a morbid obese patient assigned for surgery in prone position and documented that after turning to prone position, severe physiological abnormal signs were not recognized and concluded that these anesthetic agents were administrated appropriately for morbid obesity.

In support of the effect of obesity on recovery times, Jaoua et al. [15] using propofol/remifentanil infusion for induction and maintenance of anesthesia during laparoscopic surgery for obesity reported hemodynamic stability in 79% of patients at induction and in patients who had BMI < 49 kg/m^2 showed significantly fast time extubation than those who had BMI > 49 kg/m^2. Moreover, Diepstraten et al. [16] reported that compared with lean body weight and ideal body weight, total body weight proved to be the most predictive covariate for propofol clearance and as a result, it is anticipated that dosage of propofol for maintenance of anesthesia in morbidly obese children and adolescents should be based on TBW using an allometric function.

The impact of obesity on surgical outcome was manifested as significantly prolonged mean operative time in patients of class III compared to those of class I and II. Also, calculated amount of intraoperative blood loss, frequency of need for transfusion were significantly less in patients of class I compared to other classes with non-significantly fewer number of transfused units. Moreover, patients of class I showed significantly shorter duration till 1st ambulation and oral intake with significantly shorter duration of postoperative hospital stay compared to other groups.

These data are in hand with that previously reported in literature; Murphy et al. [17] found both anesthesia and operative times were modestly increased in obese women versus non-obese women undergoing second-trimester surgical termination, and for patients at advanced gestational age with prior cesarean delivery, clinicians should be aware of the potential increase in complications as well as increased operative time in obese women, and counsel appropriately. Gadinsky et al. [18] reported that comparing normal weight to obese class III, time differences were significant in total room time, surgery time, tourniquet time and closure time and so BMI can be used to better allocate operating room time for total knee arthroplasty. Choi et al. [19] found morbidly obese patients who undergo coronary artery bypass grafting had longer operating times, intensive care unit stays and postoperative hospital stays than the non-morbidly obese patients and these patients require considerably more resource utilization in the operating room and intensive care unit. Akbayir et al. [20] documented that endometrial cancer patients with a BMI of $\geqslant 30$ had significantly longer operating time.

Postoperative complications occurred in 16 patients with wound infection was the commonest and occurred in 11 patients, chest morbidities occurred in 6 patients and one had diabetic coma, another had acute myocardial infarction and the 16th had deep vein thrombosis. This figure coincided with Elgafy et al. [21] who previously reported that after surgery, obese patients are at higher risk for wound infection and deep vein thrombosis and with Nilsson et al. [22] obesity is an important risk factor for development of wound infection and wound healing complications and a modest increase in postoperative relative weight gain during the first postoperative day seemed to increase the risk of postoperative complications in women undergoing abdominal hysterectomy.

The obtained results and review of literature allowed concluding that obesity showed deleterious anesthetic and surgical effects with prolonged operative and recovery times and more need for blood transfusion, ICU admission and prolonged hospital stay duration. The used anesthetic regimen allowed controlled hypotension without compromising patients' general condition.

References

[1] Graves BW. The obesity epidemic: scope of the problem and management strategies. J Midwifery Womens Health 2010;55(6):568–78.

[2] Cullen A, Ferguson A. Perioperative management of the severely obese patient: a selective pathophysiological review. Can J Anaesth 2012;59(10):974–96.
[3] Pelosi P, Gregoretti C. Perioperative management of obese patients. Best Pract Res Clin Anaesthesiol 2010;24(2):211–25.
[4] Nishiyama T, Kohno Y, Koishi K. Anesthesia for bariatric surgery. Obes Surg 2012;22(2):213–9.
[5] Domi R, Laho H. Anesthetic challenges in the obese patient. J Anesth 2012 (Epub ahead of print).
[6] Bray GA. Pathophysiology of obesity. Am J Clin Nutr 1992;55:488S–94S.
[7] WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363(9403):157–63.
[8] Shook PR, Schultz JR, Reynolds JD, Spahn TE, DeBalli P. Estimating blood loss for cesarean section: how accurate are we? Anesthesiology 2003;98:1.
[9] Vella M, Galloway DJ. Laparoscopic adjustable gastric banding for severe obesity. Obes Surg 2003;13(4):642–8.
[10] Demir A, Aydınlı B, Güçlü CY, Yazıcıoğlu H, Saraç A, Elhan AH, Erdemli O. Obesity and postoperative early complications in open heart surgery. J Anesth 2012 (Epub ahead of print).
[11] van Delden PG, Houweling PL, Bencini AF, Ephraim EP, Frietman RC, van Niekerk J, van Stolk MA, Verheijen R, Wajer OJ, Mulder PG. Remifentanil-sevoflurane anesthesia for laparoscopic cholecystectomy: comparison of three dose regimens. Anesthesia 2002;57(3):212–7.
[12] Paventi S, Santevecchi A, Perilli V, Sollazzi L, Grio M, Ranieri R. Effects of remifentanil infusion bis-titrated on early recovery for obese outpatients undergoing laparoscopic cholecystectomy. Minerva Anestesiol 2002;68(9):651–7.
[13] Bidgoli J, Delesalle S, De Hert SG, Reiles E, Van der Linden PJ. A randomised trial comparing sufentanil versus remifentanil for laparoscopic gastroplasty in the morbidly obese patient. Eur J Anaesthesiol 2011;28(2):120–4.
[14] Niwa Y, Shimada N, Negishi Y, Kai M, Inoue S, Takeuchi M. Anesthetic management of a morbidly obese patient under prone position for lumbar laminectomy. Masui 2012;61(8):837–9.
[15] Jaoua H, Zghidi S, Askri A, Jendoubi A, Ammar N, Lassili S, Laaribi W, Darmoul S, Khelifi S, Ben Fadhel K. Target-controlled intravenous anesthesia during laparoscopic surgery for obesity. Tunis Med 2011;89(1):37–42.
[16] Diepstraten J, Chidambaran V, Sadhasivam S, Esslinger HR, Cox SL, Inge TH, Knibbe CA, Vinks AA. Propofol clearance in morbidly obese children and adolescents: influence of age and body size. Clin Pharmacokinet 2012;51(8):543–51.
[17] Murphy LA, Thornburg LL, Glantz JC, Wasserman EC, Stanwood NL, Betstadt SJ. Complications of surgical termination of second-trimester pregnancy in obese versus nonobese women. Contraception 2012;86(4):402–6.
[18] Gadinsky NE, Manuel JB, Lyman S, Westrich GH. Increased operating room time in patients with obesity during primary total knee arthroplasty: conflicts for scheduling. J Arthroplasty 2012;27(6):1171–6.
[19] Choi JC, Bakaeen FG, Cornwell LD, Dao TK, Coselli JS, LeMaire SA, Chu D. Morbid obesity is associated with increased resource utilization in coronary artery bypass grafting. Ann Thorac Surg 2012;94(1):23–8.
[20] Akbayır O, Corbacıoglu Esmer A, Numanoglu C, Cılesız Goksedef BP, Akca A, Bakır LV, Kuru O. Influence of body mass index on clinicopathologic features, surgical morbidity and outcome in patients with endometrial cancer. Arch Gynecol Obstet 2012 (Epub ahead of print).
[21] Elgafy H, O'Brien P, Blessinger B, Hassan A. Challenges of spine surgery in obese patients. Am J Orthop (Belle Mead NJ) 2012;41(3):E46–50.
[22] Nilsson L, Wodlin NB, Kjølhede P. Risk factors for postoperative complications after fast-track abdominal hysterectomy. Aust N Z J Obstet Gynaecol 2012;52(2):113–20.