ECRONICON OPEN ACCESS

EC EMERGENCY MEDICINE AND CRITICAL CARE
Review Article

Surgery in the Obese Patient - A Need for a Different Perspective

Zvi H Perry[1,2]*, Shahar Atias[1], Yariv Fruchtman[3], Yair Glazer[1] and Uri Netz[1]

[1]Department of Surgery "A", Soroka University Medical Center, Beersheba, Israel
[2]McGill University Hospital, Surgery Department, Bariatric Center, Canada
[3]Pediatric Division, Soroka University Medical Center, Beersheba, Israel

***Corresponding Author:** Zvi H Perry, McGill University Hospital, Surgery Department, Bariatric Center, Canada.

Received: March 26, 2019; **Published:** April 25, 2019

Abstract

Morbid Obesity is a worldwide epidemic and is believed to become the largest public health burden of the 21st century. Obesity not only alters the surgical technique, but also the disease process itself. The question is how, if at all, does this change our handling of medical and surgical management of patients who suffer from obesity?

Obesity and its prevalent co-morbidities, as well as common physiological responses to stress in the obese patient make these patients prone to perioperative and post-operative complications. In the current article we will talk about the proper evaluation of the obese surgical patient, as well as how to manage them in the peri- and post-operative period.

Keywords: *Obesity Epidemic; The Obese Patient; Risk Factors; Prevention and Treatment*

Introduction

Morbid Obesity is a worldwide epidemic and is believed to become the largest public health burden of the 21st century [1]. It seems to be the number one preventable cause of death worldwide. Obesity has been associated with varied illness states, including hypertension (HTN), diabetes, obstructive sleep apnea (OSA), ischemic heart disease (IHD), and cancer [2-5]. One has to remember that obesity is a multifactorial disease and is a condition in which excess body fat may put a person at health risk [1]. It occurs when net energy intake exceeds net energy expenditure over a prolonged period of time.

Obesity has many related factors - genetic predisposition, socialization, age, gender, race, economic status, and cultural, environmental, and emotional factors all play a role in the development of obesity [2].

One has to remember that how we look at obesity as a society in a whole, or as health professionals, has changed dramatically in the last few decades. From the bible we learned that there is a tight connection between health and obesity (Joseph's dream with 7 healthy, i.e., fat cows), and only in 1991 did WHO finally define obesity as a disease [3]. The most popular way to define obesity today is using the Body Mass Index or BMI, which is Weight (Kg)/Height (m^2). Obesity is defined as ≥ 20% than the ideal weight, or a Body Mass Index (BMI) ≥ 30 kg/m^2. A BMI of more than 25 is considered overweight, and a BMI > 40 is considered to be morbid obesity [4]. Obesity has been correlated with and is a known risk factor for many diseases, including diabetes, cardiovascular disease [5], hypertension, dyslipidemia, obstructive sleep apnea, reflux disease, gallbladder stones, fatty liver, and infertility [1,4,6-8].

The question is how, if at all, does this change our handling medical and surgical management of patients who suffer from obesity? Multiple large epidemiologic studies document risk ratios for metabolic diseases and long-term mortality with increasing BMI in obese

subjects, while overweight (BMI 25-30) subjects suffer similar albeit lower risk ratios [25]. Increased BMI is shown to predict increased cardiovascular mortality and that increase can in some cases be two to four times higher than in normal weight individuals [12].

Thus, it is not surprising that these days medical and surgical literature is looking quite differently at obese patients, and that as our understanding of obesity evolves, we start to look at obese patients as a distinct kind of patient, necessitating our special attention and evaluation.

Epstein [1], for example, has found that obese patients suffer from more post-op complications. She found that the quality of preoperative and intraoperative imaging is often compromised, potentially leading to mistaken diagnoses, and that major technical surgical limitations include poor/inadequate operative exposure and risk of suboptimal placement of instrumentation. She believes that if elective surgery is warranted in the obese patient, the risks and timing of surgical intervention should include consideration of major preoperative weight loss strategies including bariatric procedures to optimize outcomes. Similarly, in the obese patient adequate technical equipment and practical skills of all members of the anesthesia team significantly contribute to risk reduction and therapeutic success in those patients. It is not surprising to see authors like Moon and Joshi [4], who titled their article "Are morbidly obese patients suitable for ambulatory surgery?". They believe that obese patients with BMI under 40 can safely undergo ambulatory surgery, provided their comorbidities are optimized before surgery, but that super-obese patients (BMI ≥ 50 kg/m^2) have an increased risk of perioperative complications and thus should have a thorough risk assessment before considering any surgical intervention. Abdullah and Chung [5] had similar results and found that there is a higher rate of perioperative adverse events in the super-obese patients. Mavros., *et al.* [9] have found that obesity is also a risk factor for mesh infection after herniorrhaphy. Elgafy., *et al.* [3] talk about specific problems an obese patient poses for the surgical team, such as administering anesthesia, which more difficult, and proper patient positioning. Similar to that, Bryk., *et al.* [14] have reviewed the problems and risks for the endovascular surgeon caring for the obese patient and they concluded that "With obese patients, it often seems the only consideration is whether the table weight tolerance can accommodate the patient".

Post-operatively, the obese patient is at greater risk for reintubation, difficulty with pain control, wound infection, and deep vein thrombosis. When looking at the realm of anesthesiology and intensive care we see similar reservation of caring for the surgical obese patient. Cheung and Napolitano [7] have found that obese patients are at high risk even for tracheostomy placement. Pompilio., *et al.* [2] believe that obese patients pose a unique problem to ICU treatment. Ingrande., *et al*. [12] have seen that recent studies report difficulties in achieving peripheral and neuraxial blockade in obese patients.

These issues arise as a problem to a myriad of medical and surgical sub-specialties: Schreiner and Fennerty [9] found the obese patient to be a challenge to the endoscopist and have higher risk rate. Armstrong., *et al.* [15] evaluated the impact of obesity in renal transplant. It is well-established that any association of obesity with reduced patient survival in renal transplant recipients is mediated in part by its clustering with traditional cardiovascular risk factors such as hypertension, dyslipidemia, insulin resistance, and post-transplant diabetes mellitus. Thus, today we have bariatric surgery for obese (not even morbidly obese) pre-transplant patients. Similar results have been seen in obstetrics, like in Davies., *et al.* [10], who found that obese women should be advised that their fetus is at an increased risk of congenital abnormalities, have an increased risk of Caesarean section, and the risk of venous thromboembolism. It is not surprising then, that authors like Bongain., *et al.* [11] concluded that "Pregnancy in obese women should be managed as a high-risk pregnancy". Adeyemo., *et al.* [13] advocated that for the physician performing oral and maxillofacial procedures, the obese patient provides a unique challenge because of their body habitus, medical conditions, and physiologic response to treatment, all of which have significant consequences on the surgical oral/maxillofacial procedures being performed. Johansen., *et al.* [16] concluded that "Cornea surgeons must consider obesity as a potential risk factor that may be partially mitigated by careful preoperative patient evaluation, anesthesia planning, and meticulous attention to patient positioning and comfort during surgery".

Obesity not only alters the surgical technique, but also the disease process itself, as is seen in pancreatitis for example. Premkumar., *et al.* [6] have shown that obesity is associated with an amplified systemic inflammatory response in acute pancreatitis and is a prognostic factor for mortality, local and systemic complications, as well as the severity in acute pancreatitis.

So, we can conclude that obesity-prevalent co-morbidities, as well as common physiological responses to stress in the obese patient make these patients prone to perioperative and post-operative complications, the most important of which we will discuss now.

Thus, when trying to evaluate an obese patient, prior to a surgical procedure we as clinicians must be extra cautious and extend our investigation more than in a non-obese patient (just as we do in the elderly patient). When examining an obese patient there are some details that aid, and due to the fact obesity is not something that society accepts or acknowledges as a medical problem (but that of will or control), then while doing the medical interview, as well as while doing the physical examination, one must be a bit more deliberate and aware of this. For example, we all ask about past medical history. When we get the "generally healthy" answer, we tend to lower our guard. In an obese patient this must not happen. I vividly remember one of the first patients I examined as an intern prior to a bariatric surgery - I specifically asked him about prior medical history, and he grunted "I am generally healthy". Upon physical exam I could see a large sternotomy scar, from his CABG only 3 years before. When specifically asking him about this discrepancy, he told me that his thoracic surgeon has told him after his heart surgery that "he is as good as new".

In the morbidly obese patient, you should be more direct and instead of asking "Are you generally healthy?", go for more specific questions. There are 5 main essential diseases you should ask about when taking medical history - DM, dyslipidemia (due to the strong association of these two to cardio-vascular disease), HTN, OSA (due to the association of these diseases to each other and to CVA), and reflux disease.

Following is a specific approach for each:

Diabetes: Do you suffer from diabetes? And if so, on how many medications are you? Is your diabetes well-controlled with those medications? Try to see what the last HbA1c results were, as well as glucose levels for estimating the control of the disease.

Hypertension: Do you suffer from hypertension? And if so, on how many medications are you? is your hypertension well-controlled with those medications?

OSA: Do you suffer from obstructive sleep apnea? And if so, are you on a CPAP machine? Is your OSA well-controlled with the CPAP machine?

Regarding OSA, even if a patient is not diagnosed with it, you can use the STOP questionnaire (9), which is really asking the patient is s/he snoring at night? Does he/she suffer from hypertension? Is he/she tired most of the day? Does s/he fall asleep during the day inadvertently? More that 3 positive answers raise a firm suspicion for OSA.

Hypercholesterolemia: Do you suffer from hypercholesterolemia? And if so, on how many medications are you? Is your hypercholesterolemia well-controlled with those medications (ask for recent labs, including TG)?

Reflux: Do you suffer from reflux? And if so, on how many medications are you? Is your reflux well-controlled with those medications? Did you undergo an EGD?

One can quickly assess reflux disease by using the GSFQ (Gastrointestinal Short Form Questionnaire), which has 6 questions: 4 use a 5-point Likert scale (from 1 - at no time, to 5 - all the time). These questions are: a. Have you had pain or discomfort in the upper abdomen (such as burning, bloating, or fullness)? b. Have you had pain or discomfort in the area of the breast bone (such as heartburn, fullness, or sensation of blockage)? c. Have you been limited in eating a normal meal or in your choice of foods or beverages because of your stomach problems? d. Do you experience a rising, spreading, burning sensation behind your breastbone (heartburn)?

The last 2 are yes/no questions, and if the patient answers yes you add a question regarding the frequency of that problem in the last week. The questions are - a. During the past week, have your normal daily activities been affected by your heartburn? b. During the past week, has your sleep been disturbed because of your heartburn?

Scoring: The sum of these six items' scores (with possible values ranging from zero to 30) was divided by 0.3 to obtain an overall GSFQ score ranging from zero in the absence of GERD symptoms to 100 for severely affected patients.

Then you should ask about surgical history, and if the patient is not absolutely convincing, ask specifically about obesity-related procedures (gallbladder removal, hip and knees replacement, varicose veins, hiatus hernia repair, abdominal wall hernia, anti reflux procedures, etc.).

Then one must consider the peri-operative period, which puts the obese patient at more risk than an ordinary patient, as obese patients show a higher post-op complication rate than the general population [10-12] and the type of complication is quite specific to the obese patient. We will now explore the peri- and post-operative risks and complications that are unique or at a higher probability in the obese patient.

The most common and deadly post-op complications are of cardio-vascular origin. As mentioned, cardio-vascular disease is more frequent in the obese patient [3,8,13]. They typically present with chest pain or discomfort, shortage of breath, anxiety, and tachycardia. Perioperative myocardial infarction is high on the list in a patient with a known history of coronary artery disease, especially if it has required stenting or coronary artery bypass grafting in the past [2]. Typically, such a patient is on antiplatelet medication such as aspirin and clopidogrel (Plavix), which hopefully has been discontinued a week before surgery and not restarted, because of the risk of bleeding. A patient with chest pain after surgery should have an immediate 12-lead EKG and measurement of troponin levels. Elevated troponin levels or the presence of ST elevation should prompt immediate cardiology consultation, as early clot dissolution or re-stenting can limit the myocardial damage.

But, to make things even more complicated, it is harder to detect post-op complications of cardio-vascular origin in the morbidly obese patient [3]; thus the clinical story and the physical exam, as well as basic cardiac evaluation methods, are less efficient [be it the bigger abdominal and chest wall that makes US unreliable in these patients [5], or merely the larger distance for the electrical current to traverse as in ECG [14]. We have encountered patients who had post-procedural MI after undergoing bariatric surgery, and had no signs or symptoms, just a low-grade tachycardia, and only labs were able to aid us in diagnosis. We had a 37-year-old female patient, active smoker, who underwent a sleeve gastrectomy. History included hypertension, fibromyalgia, depression, anxiety, and Tourette's syndrome, and a lap cholecystectomy. She had a laparoscopic sleeve gastrectomy, in which she had some bleeding that was controlled. After surgery she was nauseated, weak, and a day post-surgery she had developed tachycardia. Labs showed an Hb of 16.7, with white blood cell count of 23,000/μl. Continuing that day, after hydration, anti-emetics, and analgesics as needed, she started suffering from epigastric pain, tachycardia that was worse, and white count that continued to rise (28.6). Other labs were normal, ECG showed no change from pre-op cardiogram. Troponin was ordered, as well as an abdominal and chest CT to r/o PE or leak. CT was normal, but troponin came back 1.78. She was admitted to ICU for observation; the next day she passed a heart angiography that showed no evidence of cardiac arteries lesions, a heart echo that was normal except for asymmetric left ventricular hypertrophy with severe thickening of the intima of the aorta without atherosclerosis. Thus, she was diagnosed as Takotsubo syndrome.

Surely one must remember that many times obese patients harbor underlying co-morbid illnesses that are un-recognized or untreated, like another patient of ours who had been sent to the community to have pre-operative evaluation and had intra-operative MI. When looking at her labs, we were horrified to find that her HbA1c was 12.7 6 months prior to surgery, and no effort was taken in the community to control her diabetes (most likely due to the fact it was a routine pre-op surgical evaluation and most likely the primary care physician was sure we as surgeons will take care of that, being unaware that we will only see her again on the day of the operation), and the stress caused by the surgery was enough to elucidate an MI. As with our case, surgeons are naturally worried about resumption of antiplatelet agents soon after surgery, but a reasonable compromise for patients who have stopped antiplatelet therapy is to resume aspirin in the recovery ward, usually by suppository, and restart other agents such as clopidogrel a week later when the risk of bleeding is diminished.

After inquiring about cardiac risk factors (such as DM, HTN, and dyslipidemia), we should go to the 2nd most lethal risk factor: thromboembolic events (VTE). The fact that a patient is obese puts him/her, due to that alone, at moderate-to-high risk for venous thromboembolism. Many factors commonly found in the obese patients who need surgery predispose them to VTE, including the mechanical effects of

super-obesity, prior VTE history, obesity hypoventilation syndrome, use of hormonal therapy, immobility, and venous stasis. Two other obesity-related risk factors for thrombo-embolic events are the surgery itself and immobility. This has led surgical societies like the ASMBS to consider mechanical and pharmaceutical DVT prophylaxis for patients who need obesity/bariatric surgery.

There is a known correlation between obesity and hypercoagulability, and the fact that immobility is a basic state after surgery, is itself a risk factor for thrombotic events.

Therefore, guidelines have been issued in recent years for the use of DVT prophylactic measures to reduce the risk when treating obese patients (mainly in bariatric surgery): pneumatic pants, rapid return to ambulation, and prophylactic use of anticoagulants (UFH + LMWH) [15]. Most surgeons advocate both mechanical and chemical modes of prophylaxis in the perioperative period, and many also recommend continuation of LMWH therapy for several weeks after discharge. But, as Bhattacharya., *et al.* stated, "There is, however, a need for consensus guidelines for DVT prophylaxis in Asian obese" [15] and there have been many conflicting studies on what to give and in what dosage [16]. In table 1 you can see some dosing regimens [17] for different agents. The dreaded sequala of DVT is pulmonary embolism (PE). PE is rare after laparoscopic bariatric surgery but is a significant risk in patients undergoing open surgery or surgery for complications especially in the context of a prolonged hospital stay. The overall incidence has been estimated at 0.9% but fatalities are estimated at 0.03%. The key features are hypoxia, hypotension, and tachypnea, the patients are often anxious, sometimes causing the symptoms to be dismissed as "hyperventilation syndrome". The patient may be cyanosed with cool sweating extremities. An EKG and chest X-ray should be done immediately, to rule out MI or tension pneumothorax. A patient with these features is suspected of pulmonary embolism until proven otherwise and needs a rapid diagnosis. A bedside echocardiogram may show right ventricular dilation, and a chest CT angiogram will show significant filling defects. CT scanning is available in most facilities and gives information about massive embolism comparable to pulmonary angiography. CT confirmation is sufficient to justify anticoagulation or thrombolysis. Massive pulmonary embolism may be so rapidly fatal that no confirmation of diagnosis is possible, and it is estimated that the majority of deaths that occur in contemporary practice from pulmonary embolism happen within an hour of the onset of the symptoms. But, to begin anticoagulation or more invasive treatment such as fibrinolytic therapy shortly after major surgery requires more than a strong clinical suspicion. The therapeutic options depend on the severity of the situation and include anticoagulation, fibrinolytic agents, catheter directed thrombolysis, and pulmonary embolectomy. Insertion of a cava filter pending the introduction of anticoagulation is often recommended in patients with new-onset deep venous thrombosis. However, prophylactic insertion of cava filters in patients with significant risk factors is more controversial and is generally not recommended [6].

BMI/Status	Enoxaparin	Dalteparin	Tinzaparin
30 - 39	Standard dosing (either 40 mg/d, or 30 mg q12h)	Standard dosing (either 5000 U/d, or 2500 U q12h)	3500 units/d
> 40	Increase standard dosing by 30% (i.e. 40 mg q12h)	Increase standard dosing by 30% (i.e. 6500 units/d)	Increase standard dosing by 30% (i.e. 4500 units/d)
> 50 (mainly in bariatric surgery)	60 mg q12h		

Table 1: *Different DVT prophylaxis regimens.*

The third possible severe complication is respiratory failure. As discussed, OSA is quite frequent in the obese patient [18], which means that they are more prone to have more post-op and intra-op complications [19]. This starts from having a technically harder intubation in the obese patient [20], as well as a higher chance of atelectasis - either due to inadequate analgesia [as mentioned, the pharmacokinetics in obese patients is different [21], or due to over-sedation, which leads to respiratory depression and airway compromise (especially with OSA [18,19]).

Another risk that obesity poses in the respiratory realm, is Aspiration - Obese patients have larger gastric fluid volume, they suffer from increased intra-abdominal pressure and a higher incidence and prevalence of GERD [22], all of which are known risk factors for aspiration, which may cause chemical pneumonia [18,23,24]. OSA is quite prevalent amongst obese patients (as much as 60% of the patients with metabolic syndrome are assumed to suffer from OSA [25]). As we have shown, these patients are harder to intubate and suffer from a higher rate of post-op respiratory failure [3,6,26-28]; thus if these patients are already treated (i.e. with a CPAP machine), they have to bring it with them to the operation, or if they have none at least be under direct supervision (like in an ICU setting) so if they stop breathing (as they do each and every night) this could be countered with the needed medical assistance. That is why OSA patients in our facility stay a night after surgery in the ICU.

As noted, obese patients are more prone to infection and are in a sense immuno-compromised - obesity in itself is a systemic inflammatory condition and shows widespread tissue injury, which makes those patients more prone to infections [6,29-31]. One must remember that adipose tissue is poorly vascularized, which leads to impaired wound healing [1,28,32]. If we add this to the higher prevalence of diabetes amongst obese patients, it is not surprising to find a higher rate of wound infection and even sepsis among obese patients [33-35]. To make things worse, due to this immunological compromise obese patients who suffer from infection do not show this in the regular immunological fashion (i.e. fever, tachycardia, elevated blood count). We had a patient who underwent a sleeve gastrectomy and suffered from a gastric leak. She had an abdominal collection and leak with no peritoneal signs, no fever, no tachycardia, and only a mild lowering of saturation, with a minimal elevation in white blood cell count.

Some complications are related to how we position our patients and are due to the mere pressure an obese patient exerts when he lies down. These include pressure ulcers, rhabdomyolysis, and nerve injuries. Rhabdomyolysis is rare, but is immediately recognizable, like in rhabdomyolysis of the gluteal muscles, which presents with severe pain in the buttocks or legs.

It appears to be the result of pressure necrosis of the muscles, initially by unrelieved pressure on the operating table, and it is amplified by edema and swelling within the gluteal muscle compartment [19]. If unrecognized, extensive skin necrosis overlying the gluteal muscles may develop. It is most often noted in superobese males with diabetes and central obesity who have a prolonged operative procedure. The swollen muscle can compress the sciatic nerve or its roots and can release myoglobin and cause renal failure. The diagnosis is easy by looking at the labs and finding elevated creatine kinase (CK) levels. After uncomplicated surgery, CK levels may be up to 1200 units/l in the first 48 hours, but rhabdomyolysis causes values of 30,000 units/l or even more. It is important not to dismiss the symptoms as due to "arthritis" or its cutaneous manifestation as a decubitus ulcer, because immediate decompression may limit the loss of muscle and nerve injury. Since it was first described, widespread attention to careful padding on the operating table, as well as limiting the duration of surgery in high risk patients helped in prevention and reduction of this debilitating complication.

A related complication is nerve injury - compression of peripheral nerves such as the ulnar or common peroneal nerve may occur because of positioning on the operating table, especially during a lengthy operation. Traction injury to the brachial plexus may occur if the angle of the outstretched arms on the operating table is greater than 90°. When the table is put into reverse Trendelenburg position, the body tends to slide down the table and increase this angle, leading to a traction injury causing dysesthesia and motor weakness in the arms and hands. This is seen even in normal weight patients but is a lot more detrimental in obese and super-obese patients. When a patient reports such findings after surgery, it is important to document the time of onset and to obtain a prompt neurological consultation, because persistence of the symptoms may prompt the patient to file a lawsuit, especially if there was a perception that the complaint was not taken seriously [20-22]. Thus, as we know that the best prevention in primary in nature, when we consider positioning of the patient in the surgical bed, we should use padding and positioning devices that will maintain a normal capillary interface pressure of < 32 mmHg and reduce the risk of OR acquired pressure ulcers, as is seen in figure 1.

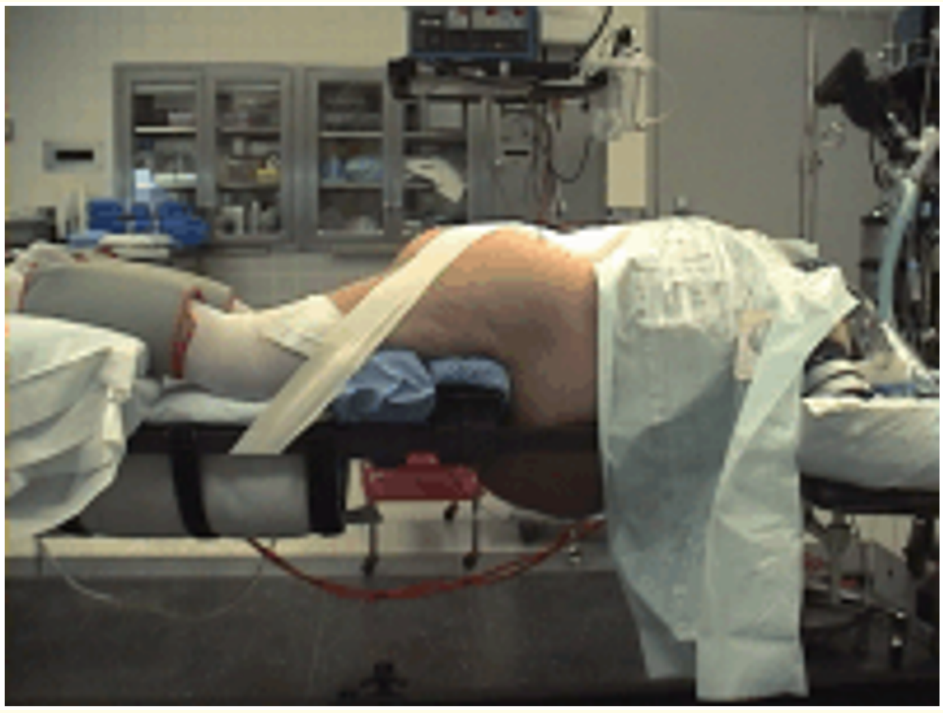

Figure 1: *Proper positioning and padding of an obese surgical candidate.*

Conclusion

Morbid obesity is a worldwide epidemic and it is believed to become the largest public health burden of the 21st century. Obesity has been correlated and is a risk factor for many diseases, including type 2 diabetes, cardiovascular disease, hypertension, dyslipidemia, obstructive sleep apnea, reflux disease, gallbladder stones, fatty liver, infertility, thromboembolism, malignancy, and many others. The question is how, if at all, does this change our handling the management of the obese patient?

In the current article we have tried to shed some light on the major obstacles in caring for the surgical obese patient and have shown that many of the obstacles and treatment regimens are also good for the non-surgical obese patient. The obese patient tends to mask abdominal illness and even catastrophes due to the thick abdominal wall and ample reserves these patients have. Thus, for example, if we remember that in a normal person bleeding more than a liter can cause shock, in an obese patient, due to the larger blood volume this amount can be doubled before we see any signs of shock. Many obese patients suffer from diabetes, which puts them in a state of immune suppression, which means they are unable to mount an immunological response (i.e. no fever) and have a higher chance of wound infection.

On the other hand, due to the fact these patients are considered to be at higher risk, we sometimes go to the other extreme and operate even before all other diagnoses are excluded (we did a diagnostic lap on a patient who had a UTI, due to fever). Thus, only meticulous pre-operative evaluation of the obese patient, and knowledge of the unique set of complications and problems that obese patients tend to suffer from can aid us in properly treating those patients.

Bibliography

1. Huschak Gerald., *et al*. "Obesity in anesthesia and intensive care". *Best Practice and Research Clinical Endocrinology and Metabolism* 27.2 (2013): 247-260.

2. Lascano CA., *et al*. "Challenges of laparoscopic colectomy in the obese patient: a review". *American Journal of Surgery* 192.3 (2006): 357-365.

3. Pompilio CE., *et al*. "The Bariatric Patient in the Intensive Care Unit: Pitfalls and Management". *Current Atherosclerosis Reports* 18.9 (2016): 55.

4. De Lorenzo A., *et al*. ""Metabolically Healthy" Obesity: Fact or Threat?" *Current Diabetes Reviews* 14.5 (2018): 405-410.

5. Abdullah A., *et al*. "Estimating the risk of cardiovascular disease using an obese-years metric". *BMJ Open* 4.9 (2014): e005629.

6. Koba P. "Identifying Obstacles for the Obese Trauma Patient". *Journal of Trauma Nursing* 23.1 (2016): 45-48.

7. Freitas AI., *et al*. "Time trends in prevalence and incidence rates of childhood overweight and obesity in Portugal: Generation XXI birth cohort". *International Journal of Obesity* 43 (2018): 424-427.

8. Epstein NE. "More risks and complications for elective spine surgery in morbidly obese patients". *Surgical Neurology International* 8 (2017): 66.

9. Chiu HY., *et al*. "Diagnostic accuracy of the Berlin questionnaire, STOP-BANG, STOP, and Epworth sleepiness scale in detecting obstructive sleep apnea: A bivariate meta-analysis". *Sleep Medicine Reviews* 36 (2017): 57-70.

10. Fobi MA. "Surgical treatment of obesity: a review". *Journal of the National Medical Association* 96.1 (2004): 61-75.

11. Hensrud DD and Klein S. "Extreme obesity: a new medical crisis in the United States". *Mayo Clinic Proceedings* 81.10 (2006): S5-S10.

12. Khan S., *et al*. "Trends in bariatric surgery from 2008 to 2012". *American Journal of Surgery* 211.6 (2016): 1041-1046.

13. Kenkre J., *et al*. "Treating the obese diabetic". *Expert Review of Clinical Pharmacology* 6.2 (2013): 171-183.

14. Kurisu S., *et al*. "Frontal QRS-T angle and World Health Organization classification for body mass index". *International Journal of Cardiology* 272 (2018): 185-188.

15. Bhattacharya S., *et al*. "Deep vein thrombosis prophylaxis: Are we overdoing? An Asian survey on trends in bariatric surgery with a systematic review of literature". *Journal of Minimal Access Surgery* 14.4 (2018): 285-290.

16. Beall J., *et al*. "Efficacy and Safety of High-Dose Subcutaneous Unfractionated Heparin Prophylaxis for the Prevention of Venous Thromboembolism in Obese Hospitalized Patients". *Hospital Pharmacy* 51.5 (2016): 376-381.

17. Vandiver JW., *et al*. "Chemical prophylaxis to prevent venous thromboembolism in morbid obesity: literature review and dosing recommendations". *Journal of Thrombosis and Thrombolysis* 41.3 (2016): 475-481.

18. Porhomayon J., *et al*. "Strategies in postoperative analgesia in the obese obstructive sleep apnea patient". *Clinical Journal of Pain* 29.11 (2013): 998-1005.

19. Winfield RD. "Caring for the critically ill obese patient: challenges and opportunities". *Nutrition in Clinical Practice* 29.6 (2014): 747-750.

20. Petrini F., *et al*. "Perioperative and periprocedural airway management and respiratory safety for the obese patient: 2016 SIAARTI Consensus". *Minerva Anestesiologica* 82.12 (2016): 1314-1335.

21. Willis S., *et al*. "Perioperative Pharmacologic Considerations in Obesity". *Anesthesiology Clinics* 35.2 (2017): 247-257.

22. Reavis KM. "Management of the obese patient with gastroesophageal reflux disease". *Thoracic Surgery Clinics* 21.4 (2011): 489-498.

23. Pirrone M., *et al*. "Recruitment Maneuvers and Positive End-Expiratory Pressure Titration in Morbidly Obese ICU Patients". *Critical Care Medicine* 44.2 (2016): 300-307.

24. Lang LH., *et al*. "Perioperative management of the obese surgical patient". *British Medical Bulletin* 124.1 (2017): 135-155.

25. Drager LF., *et al*. "Obstructive sleep apnea: a cardiometabolic risk in obesity and the metabolic syndrome". *Journal of the American College of Cardiology* 62.7 (2013): 569-576.

26. El Solh AA. "Airway management in the obese patient". *Clinics in Chest Medicine* 30.3 (2009): 555-568.

27. Carpaij OA and van den Berge M. "The asthma-obesity relationship: underlying mechanisms and treatment implications". *Current Opinion in Pulmonary Medicine* 24.1 (2018): 42-49.

28. Bluth T., *et al*. "The obese patient undergoing nonbariatric surgery". *Current Opinion in Anesthesiology* 29.3 (2016): 421-429.

29. Al-Dorzi HM., *et al*. "Antibiotic therapy of pneumonia in the obese patient: dosing and delivery". *Current Opinion in Infectious Diseases* 27.2 (2014): 165-173.

30. Elgafy H., *et al*. "Critical care of obese patients during and after spine surgery". *World Journal of Critical Care Medicine* 5.1 (2016): 83-88.

31. Gil JS., *et al*. "The impact of metabolic syndrome on metabolic, pro-inflammatory and prothrombotic markers according to the presence of high blood pressure criterion". *Clinics (Sao Paulo)* 68.12 (2013): 1495-1501.

32. Grupper M and Nicolau DP. "Obesity and skin and soft tissue infections: how to optimize antimicrobial usage for prevention and treatment?" *Current Opinion in Infectious Diseases* 30.2 (2017): 180-191.

33. Tewari N., *et al*. "Obesity-related insulin resistance: implications for the surgical patient". *International Journal of Obesity* 39.11 (2015): 1575-1588.

34. Abdullah HR and Chung F. "Perioperative management for the obese outpatient". *Current Opinion in Anesthesiology* 27.6 (2014): 576-582.

35. Mathison CJ. "Skin and wound care challenges in the hospitalized morbidly obese patient". *Journal of Wound, Ostomy and Continence Nursing* 30.2 (2003): 78-83.

Volume 3 Issue 5 May 2019