RCS
ADVANCING SURGICAL STANDARDS

Jyoti Shah, Jo Fitz-Henry Series Editors
E: jyoti.shah@burtonft.nhs.uk, jo.fitz-henry@nuh.nhs.uk

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peri-operative care series

Big is not always best. The prevalence of obesity has nearly doubled since 1980 and according to the World Health Organization, there are more than one billion overweight adults, with more than 300 million of them being obese. Much closer to home, British women have the sixth-highest body mass index in Europe.

The obesity epidemic is now of global concern, affecting developed and developing countries, and is associated with a wide spectrum of medical and surgical pathologies. Hence we are all likely to be presented with an obese patient in our respective specialties at some point soon. With the recent publication of the UK national bariatric surgery report, Dr Nick Reynolds's article on obesity is a timely reminder of how to manage the challenge of an obese patient on our operating lists.

Nick is a consultant in anaesthesia and intensive care medicine, and is based at the regional obesity service, Royal Derby Hospital. His unit is one of the largest NHS providers of bariatric surgery, receiving over 700 referrals per year and performing about 400 bariatric surgical procedures across the full range of operations to a population of approximately 3 million.

JYOTI SHAH
Associate Editor

Breathtaking obesity?

Nick Reynolds
Consultant in Anaesthesia and Intensive Care Medicine, Royal Derby Hospital

CORRESPONDENCE TO
Nick Reynolds, Consultant in Anaesthesia and Intensive Care Medicine, Royal Derby Hospital, Uttoxeter Road, Derby DE22 3NE
E: Nicholas.Reynolds@derbyhospitals.nhs.uk

Question

A 38-year-old patient requires pre-operative assessment for elective laparoscopic cholecystectomy after presenting with right upper quadrant pain, caused by gallstones. She is 1.65m tall and weighs 164kg. She complains of breathlessness on minimal physical exertion (<10 metres) and sleeps sitting up. She has a rapid irregular pulse and significant pedal oedema. What factors will you consider at her pre-assessment?

The UK population is rapidly putting on weight.[1] Body mass index (BMI) is widely used to define obesity (Table 1).

Breathlessness and lack of physical activity are common in patients with high BMIs. One-third will report dyspnoea and one-quarter, complete physical inactivity.[2]

Mortality

Elevated BMI states are associated with an 'all cause of death' hazard ratio of up to 3. The relative risk of conditions including coronary arterial disease, hypertension, diabetes and cholelithiasis rises by a factor of between 2 and 8 between populations with BMI 21–26. Additionally, morbidly obese patients are at a greater risk of mortality from these conditions (Table 2). Premature mortality for a morbidly obese 30-year-old may exceed 14 years, with many preceding years of associated co-morbidity.

Table 1 Definition of obesity

BMI (kg/m^2)	
<25	Normal
25–30	Overweight
30–35	Obese
>35	Morbidly obese
>55	Super-morbidly obese

Fat distribution

Adipose tissue is the common tissue uniting the underlying multiple organ pathophysiology of obesity. Abdominal visceral fat (AVF) is recognised as an endocrine and immunologically active tissue compared with fat in the peripheral

Table 2 Prevalence of co-morbidity in obese patients

50% Hypertension
25% Asthma
50% Arthritis
30% Diabetes (associated with hepatic steatosis)
Increased incidence of malignancy

distribution (hips, buttocks, thighs). AVF is therefore associated with more metabolic complications such as diabetes mellitus and ischaemic heart disease.

Conditions associated with functional exercise limitation in obesity

Cardiovascular system

Obesity is associated with many cardiac risk factors (Table 3).

Morbidly obese patients have limited mobility and may be asymptomatic despite significant cardiovascular disease. Signs such as raised jugular venous pressure and peripheral oedema are common, but may be difficult to see. Chronic volume overload, lymphatic insufficiency and reduced muscle pump activity contribute. However, both can also be related to congestive cardiac failure. Cardiomyopathy is common. A structurally normal heart is found in only 10% of metabolic syndrome patients with a BMI>45. One-third will have a hypertrophic and dilated cardiomyopathy, causing both systolic and diastolic heart failure.

Sinus tachycardia is the most common electrocardiogram (ECG) change. The incidence of atrial fibrillation (AF) increases with obesity, as does the risk of relapse when treated. In particular, obesity and sleep-disordered breathing (SDB), is associated with left atrial dilatation, which is a major risk factor for AF.

Echocardiography is frequently utilised as a pre-operative investigation for those patients at high risk of cardiac disease. However, adequate trans-thoracic imaging windows are acknowledged to be technically extremely difficult in the obese population. Transoesophageal (TOE) imaging may be more fruitful but is neither routine nor readily accessible in many UK centres. Even TOE may produce severely limited images in one-third of patients.

Image quality limitations apply to the forms of isotope and radiographic imaging. In addition, consideration must be given to the practical limitations of the equipment available. Most UK imaging facilities, for example, angiography, CT and MRI suites, have a ceiling of approximately 150kg or a scanning orifice of less than 1 metre.

Respiratory system

PULMONARY FUNCTION: The onset of pulmonary impairment is observed from surprisingly low BMI states (26–35) (Table 4). Pulmonary function tests show mixed obstructive and restrictive patterns. Work of breathing rises, compliance of both lung and chest wall decreases and there is increased airway flow resistance. 'Asthmatic' disease incidence is 5 times that of the normal BMI population but reversibility is not guaranteed.

Table 3 Cardiovascular risk factors in obesity

Hypertension
Ischaemic heart disease
Cardiomyopathy
Venous thrombosis
Right or left ventricular failure
Arrhythmias
Relative risk of 1.6 for cardiovascular death in BMI>30

Table 4 Respiratory disorders associated with obesity

Restrictive lung disease
Asthmatic disease
Obstructive sleep apnoea/obesity hypoventilation syndrome/central sleep apnoea
Difficult airway

Neuraxial anaesthesia (spinal and epidural) is often perceived as the mandated option in the obese. Care needs to be taken as these techniques will cause a fall of 20–30% from baseline pulmonary function. If these techniques are utilised simultaneously with supine, Trendelenburg or lithotomy positioning, respiratory failure can rapidly result.

SLEEP DISORDERED BREATHING: SDB encompasses obstructive sleep apnoea (OSA), central sleep apnoea (CSA) and obesity hypoventilation syndrome (OHS). In the general population, 2–4% will have OSA on sleep study testing, 60–90% will have a BMI>30, with approximately one-third exhibiting features of CSA or OHS. These syndromes are more sinister in the peri-operative period, as their presence can predict exquisite sensitivity to the respiratory depressant effects of opiate and sedatives. SDB is a major risk factor for hypertension and cardiomyopathy.

Patients with severe disease will report sleeping erect, often in a chair. Questionnaire symptom scoring, eg the Epworth Sleepiness Scale or the STOP–BANG model, can detect about 90% of SDB and rationalise referral for sleep testing. Treatment includes reversal of precipitants (evening alcohol consumption or night sedation), weight loss and nocturnal continuous positive airway pressure (CPAP). CPAP therapy even for 6 weeks can reverse some of the most serious peri-operative risk factors.

AIRWAY: Obese patients tend to have large necks but a narrowed internal upper airway due to excess palatal, pharyngeal and laryngeal soft-tissue lipid infiltration. Mask ventilation is often difficult. Challenging intubation correlates better with neck circumference (>40cm) and standard predictive tests than BMI and often is mitigated by the use of a 'ramped' postion at intubation.

Table 5 Other conditions associated with obesity

Endocrine disease	Impaired glucose tolerance
	Diabetes mellitus
	Cushing's disease
Gastrointestinal disease	Hiatus hernia
	Gallstones
Biochemistry	Hypercholesterolaemia
	Deranged lipid levels
Miscellaneous	Osteoarthritis in weight-bearing joints
	Increased risk of wound infections

Thromboembolic disease

Venous thromboembolism (VTE) remains the leading cause of death in bariatric surgical practice. There are biochemical data to suggest that obesity is a pro-coagulant state. Venous stasis may be induced by operative positioning (particularly lithotomy) and increased abdominal pressures, exacerbated by peritoneal insufflation. These have been shown to reduce femoral vein blood-flow velocities dramatically. BMI>30 with oral contraceptive use is associated with a 10-fold increase in deep vein thrombosis incidence in females.

Other conditions associated with obesity are listed in Table 5.

Pre-operative evaluation

- Take a detailed history looking particularly for evidence of snoring, daytime somnolence and sleep patterns (such as upright in a chair). Further information may be obtained from a relative.
- Ask the patient to walk the length of the ward to reveal reduced exercise tolerance.
- Examine the patient to look for signs of cardiac failure.
- Assess the airway (head and neck flexion/mouth opening); inspect oropharynx.
- Blood tests should include full blood count (looking for polycythaemia), vitamin B12 and folate (nutritional state), and coagulation (metabolic abnormalities).
- Spirometry and blood gases tests (supine and upright) should be undertaken.
- Check blood pressure using a cuff that should be 20% greater than the diameter of the upper arm. A conical upper arm shape is common in high BMI states and forearm cuff readings are frequently utilised in bariatric practice.
- ECG: Low voltage and axis changes may be normal due to excess overlying tissue.
- Chest x-ray: exclude cardiomegaly.
- Intravenous access may be difficult and so consider facilitating even peripheral venous access using ultrasound equipment. Central access may be necessary.

The prediction and assessment of surgical risk in higher BMI patients may be analogous to trying to assess risk purely by age.[3] Objective testing of functional reserve through cardiopulmonary reserve in both groups may hold the answer for the identification of the high-risk high BMI. Cardiopulmonary exercise testing (CPET) is a multi-modal assessment that may offer insight into factors causing functional limitation in obese patients. The patient is exercised on a treadmill or cycle ergometer, which has a mass limit over 250kg. Continuous multi-channel ECG and respiratory data including spirometry and gas exchange are collected as exercise effort is measured and sequentially increased.

The measurements collected during CPET can identify those where functional dyspnoea is purely effort related, caused by isolated cardiac or pulmonary limitation, or combined disease. CPET may predict not only cardiac, but overall major complication rates.[4]

DRUG HANDLING: Opioid and sedative drugs can cause respiratory depression and should be avoided. Obese patients have a high incidence of gastro-oesophageal reflux disease and should be considered for prophylaxis against aspiration. For example, by using a combination of an acid suppressant (eg ranitidine 150mg or omeprazole 20–40mg) and prokinetic (metoclopramide 10mg) 12 and 2 hours prior to the procedure, respectively.

- Continue steroids and cardiovascular drugs pre-operatively.
- Omit angiotensin-converting enzyme inhibitors on the day of surgery (which may lead to profound hypotension).
- Multi-modal VTE prophylaxis should be given, encompassing early mobilisation and heparinoids. Consider continuing after the patient is mobile and possibly even after discharge.

Intra-operative factors

Most theatre tables accommodate weights of approximately 130kg but may be too narrow. 'Overflow' increases the risk of pressure sores and nerve injuries. These areas need protection using bean bags and arm gutters. Elevated arm boards may be required to support shoulders adequately in those with 'buffalo' backs, thereby avoiding brachial plexus injuries from hyperextension.

- Position the patient on the operating table prior to induction to avoid unnecessary transfer.
- Evidence-based VTE protocols must be followed in theatre.

Post-operative management

Clinical scoring systems such as the obesity surgery mortality risk score and the Montefiore obesity surgery score can aid decisions regarding the appropriate level of post-operative care. Age more than 45 years, BMI>50 or patients with a history of asthma/snoring, hypertension or previous VTE

may be higher risk and should be considered for specialised care post-operatively.[5,6]

Patients should be recovered 45 degrees head up, ideally in the beach-chair position, with optimal analgesia and continuous pulse oximetry. Patients at risk of arrthythmias need continuous ECG monitoring. Early mobilisation and incentive spirometry may mitigate respiratory complications.

In conclusion, the management of such a patient as mentioned at the start of this article in our centre was to assess and subsequently treat the identified obstructive sleep apnoea. Optimal pharmacological treatment for hypertension, AF and specialist dietetic and diabetic management was instigated. Echocardiography was unrewarding. CPET testing revealed a pattern suggesting early onset of symptoms of breathlessness below maximal physiological effort, with reassuring indices of actual cardiopulmonary reserve. Risk counselling, management of patient expectations and a VTE prophylaxis regimen including mechanical, pharmacological and aggressive early mobilisation all contributed to an uncomplicated peri-operative course.

Take-home messages

- All patients must have an accurate BMI.
- Obesity is a multi-organ disease.
- Cardiorespiratory disease is common.
- Morbidity and mortality increase with increased BMI.

References

1. Office of Health Economics. *Shedding the Pounds: Obesity Management, NICE Guidance and Bariatric Surgery in England.* London: OHE; November 2010.
2. Karason K, Lindroos AK, Stenlöf K, Sjöström L. Relief of cardiorespiratory symptoms and increased physical activity after surgically induced weight loss: results from the Swedish Obese Subjects study. *Arch Intern Med* 2000; **160**: 1,797–1,802.
3. Older P, Hall A, Hader R. Cardiopulmonary exercise testing as a screening test for perioperative management of major surgery in the elderly. *Chest* 1999; **116**: 355–362.
4. Balady GJ, Arena R, Sietsema K *et al.* Clinician's Guide to cardiopulmonary exercise testing in adults: a scientific statement from the American Heart Association. *Circulation* 2010; **122**: 191–225.
5. Jayaraman L, Sethi N, Sharma S, Sood J. Anaesthesia for bariatric surgery – Laparoscopic adjustable gastric banding case series. *Journal of Anaesthesiology Clinical Pharmacology* 2006; **22**: 403–408
6. DeMaria EJ, Murr M, Byrne TK *et al.* Validation of the obesity surgery mortality risk score in a multicenter study proves it stratifies mortality risk in patients undergoing gastric bypass for morbid obesity. *Ann Surg* 2007; **246**: 578–582.