Guidance for the Perioperative Management of the Morbidly Obese Surgical Patient

Purpose

The prevalence of obesity in the UK has increased significantly in recent years. Greater numbers of obese patients are presenting for both elective and emergency surgery and the risk associated with anaesthesia and surgery is higher in this group of patients. The specific needs of these patients must therefore be addressed. Safe and successful treatment requires a level of organisational commitment, expertise and staff training.

The Association of Anaesthetists of Great Britain has published guidelines for the perioperative management of the morbidly obese patient. https://www.aagbi.org/sites/default/files/Peri_operative_management_obese_patientWEB.pdf

This document expands upon these guidelines with particular relevance for practice at the Bradford Teaching Hospitals NHS Foundation Trust.

Scope

Patients undergoing surgery with elevate Body Mass Index. Obesity is defined as a BMI > 30 kg/m2. Morbid obesity refers to those with a BMI > 40 kg/m2.

Definitions/Glossary of Terms

AAGBI: Association of Anaesthestists of Great Britain and Ireland
ABW: Adjusted body weight
ASA: American Society of Anesthesiologists
BMI: Body Mass Index
IBW: Ideal body weight
LBW: Lean body weight
OSA: Obstructive Sleep Apnoea
SOBA: Society for Obesity and Bariatric Surgery
TBW: Total body weight

INTRODUCTION

Identification and Classification of Obesity

Body mass index (BMI) should be used in adults. Obesity is defined as a BMI > 30 kg/m2. Morbid obesity refers to those with a BMI > 40 kg/m2.

The World Health Organization definitions of obesity are as classified:

	BMI
Normal range	18.5–25
Overweight	≥25
Pre-obese	25–30
Obese	≥30
Obese class I	30–35
Obese class II	35–40
Obese class III (morbidly obese)	≥40

Body Mass Index (BMI) – Weight in Kg divided by square of height in meters (kg/m2

Risk Stratification based on Waist / Neck Circumference

In some populations, waist circumference may be a better indicator of risk than BMI e.g. in persons of Asian descent. It is now well known that people who carry their excess fat centrally (within the abdominal cavity) are more likely to suffer the consequences of being overweight.

Increased waist circumference is also associated with the metabolic syndrome. The WHO definition for metabolic syndrome is: 'Type 2 diabetes, impaired glucose tolerance or normal glucose tolerance with insulin resistance, together with two or more of the following:

1. Elevated blood pressure

2. Abdominal obesity and/or BMI >30kg/m2

3. Low HDL cholesterol

4. High triglycerides

5. Microalbuminuria

Patients with metabolic syndrome are at an increased risk of cardiovascular

disease equivalent to people with frank type 2 diabetes.

The waist circumference measurement for men and women at which there is an increased relative risk is defined as follows:

	Increased risk	Substantially increased risk
Men	>/= 94cm	>/= 102 cm
Women	>/= 80cm	>/= 88cm

In patients with a BMI in the region of 25 to 35 kg/m2 incorporating measurements of waist circumference will provide additional information about risk and can be used an additional measure of progress with weight loss. But in those with a BMI >35 kg/m2, waist circumference has little added predictive power of disease risk.

Neck Circumference

It is well known that men with a collar size of greater than 43 cm or 17 inches are at an increased risk of developing Obstructive Sleep Apnoea (OSA). Therefore, in addition to BMI, neck circumference measurements are another useful tool to monitor weight loss and risk for development of OSA.

A large neck circumference is a useful additional indicator and when greater than 60 cm, is associated with a 35% probability of difficult laryngoscopy.

Bag-mask ventilation is known to be more difficult in the obese and desaturation can occur quickly.

Drug Dosing

There is limited information on the effect of obesity on the pharmacology of commonly used anaesthetic drugs. Much of the excess weight is fat, which has a relatively low blood flow. While lipophilic drugs will have a larger volume of distribution than hydrophilic ones, the current evidence indicates that changes in volume of distribution in the obese are drug-specific, so generalisations are difficult. For most anaesthetic agents, dosing to total body weight is rarely appropriate and increases the risk of relative overdose. Fortunately, most anaesthetic agents are dosed to affect, e.g. loss of eyelash reflex, nerve stimulator response or relief of pain. Given the paucity of information, the recommendation, based on current practice amongst experts in bariatric anaesthesia, is that lean or adjusted body weight are used as the scalars for calculating initial anaesthetic drug doses rather than total body weight.

Measurement	Definition

Total body weight (TBW)	The actual weight of the patient
Ideal body weight (IBW)	What the patient should weigh with a normal ratio of lean to fat mass. Varies with age, and is usually approximated to a function of height and sex: IBW (kg) = height (cm) – x (where x is 105 in females and 100 in males)
Lean body weight (LBW)	The patient's weight excluding fat. Many of the formulae for calculating lean body weight are complex but one of the most widely used is that of Janmahasatian et al.: Regardless of total body weight, lean body weight rarely exceeds 100 kg in men and 70 kg in women
Adjusted body weight (ABW)	Takes into account the fact that obese individuals have increased lean body mass and an increased volume of distribution for drugs. It is calculated by adding 40% of the excess weight to the IBW: ABW (kg) = IBW (kg) + 0.4 (TBW (kg) - IBW (kg))

Suggested initial dosing scalars for commonly used anaesthetic drugs for healthy obese adults

Lean body weight (up to a maximum of 100kg in men and 70kg in women)	Adjusted body weight Ideal plus 40% excess
Propofol (induction) Thiopentone Fentanyl Rocuronium Atracurium Morphine Paracetamol Bupivicaine Lignocaine	Propofol (infusion) Antibiotics LMW heparin Alfentanil Neostigmine (max 5 mg) Sugammadex (see product literature)

PRE-OPERATIVE ASSESSMENT

Obstructive sleep apnoea (OSA) is relatively common and likely to be significantly underdiagnosed. Patients with OSA are particularly sensitives to sedatives and opioid analgesics and at the severe end of the spectrum is a group of patients with Obesity Hypoventilation Syndrome with chronic blood gas abnormalities and associated cardiovascular pathology.
Patients attending pre-operative assessment clinic with a BMI of greater than 40 should have STOP-BANG completed and then be referred through the pre-operative assessment agreed pathways as appropriate.

STOP-BANG questionnaire

Snore	do you snore loudly (enough to be heard through a closed door)?
Tired	do you often feel tired or sleepy during the day?
Observed	has anyone ever seen you stop breathing whilst asleep?
(blood) **P**ressure	Do you have or are you being treated for high blood pressure
BMI	is your BMI >35?
Age	are you over 50?
Neck	is your neck circumference >40cm?
Gender	are you male?

For the general population with unknown OSA status (see appendix 2)

Yes to 0-2 questions: low risk of OSA
Yes to 3-5 questions: Intermediate risk of OSA, requires referral to consultant led PAC
Yes to 6-8 questions: High risk of moderate to severe OSA, requires referral for sleep studies

For obese patients with unknown obstructive sleep apnoea status (i.e. those undergoing urgent/emergency surgery or who haven't been to pre-operative clinic), the SOBA recommendations should form a basis for the post-operative management plan for obese patients. The summary slide is included in the appendix section.

Patients with mild or OSA established for 6 weeks on CPAP can generally be managed in a ward setting with their own CPAP.

PERIOPERATIVE CARE

Pre-medication

Sedative premedication is not advisable if the patient is expected to self-transfer in theatre and because of the risks of post-operative respiratory depression.

If difficult intubation is anticipated or an awake fibreoptic intubation is planned, then an anti-sialagogue such as glycopyrrolate may be prescribed.

Equipment

The theatre tables and beds are available and have the following weight limits:

Eschmann T20 operating tables- 47 Stone (300 kilo)

Maquet operating table- 55 Stone (350 kilo)

Additional equipment available includes, extra side supports to fit both tables, large flowtron boots, and Yellowfinn bariatric LD boots.

Conduct of Anaesthesia

All necessary equipment must be identified, available, and be in working condition before the start of surgery. Induction of anaesthesia can occur in theatre with appropriate monitoring in place, if necessary. Consideration should be given to using direct arterial blood pressure measurement for surgery as non-invasive blood pressure readings can be inaccurate.

Patient Positioning

Strong consideration should be given to anaesthetising the patient in theatre. If appropriate, the patient should be encouraged to get on the theatre table and position themselves. A step may be helpful. This will minimise the risk of manual handling injury to staff. If the patient is going to position themselves then it is important that they receive no preoperative sedation which may impair their ability to cooperate. If manual handling is necessary, the hover mattress should be used and their safe operating weight limit is 500kg. Alternatively, a patslide and slide sheet can be used with a minimum of 4 people pulling the patient across.

All potential pressure points must be adequately padded after the patient is positioned on the table and before the induction of anaesthesia. The risk of pressure sores and neural injuries from prolonged stasis during surgery is higher in the obese patient compared to that of a normal weight patient. Obesity is normally associated with significant physiological changes. Additionally, different surgical positions can further alter baseline cardiovascular and pulmonary function.

Supine Position

For any patient, changing from the standing to the supine position causes an increase in venous blood return to the heart. Cardiac output, pulmonary blood flow and arterial blood pressure all increase after assuming the supine position. General anaesthesia with muscle paralysis causes a reduction in lung volumes in every patient. In obese patients, the cardiorespiratory changes are exaggerated.

Supine patients have relative hypoxia and significant alterations in the mechanical properties of their respiratory system with marked reductions in lung volume. In the supine position, intra-abdominal pressure is increased causing a splinting effect of abdominal contents on the diaphragm.

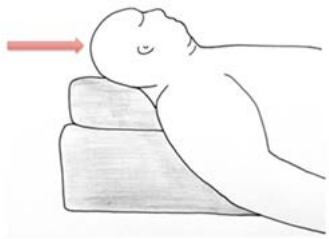
Changing from the sitting to supine position can cause significant increases in oxygen consumption, cardiac output and pulmonary artery pressure. By lying supine, the already poor chest wall compliance can deteriorate and further

V/Q mismatch can occur. An already hyperactive, borderline hypoxic heart can decompensate. These changes can lead to fatal cardiorespiratory decompensation (Obesity Supine Death Syndrome) in obese patients with inadequate cardiac reserve. Compression of the inferior vena cava must also be avoided. This can be accomplished by tilting the table or placing a wedge under the patient (extreme care required when using lateral tilt with an obese patient).

Prior to induction of anaesthesia the obese patient should be ‘ramped’ with pillows and/or towels under the shoulders such that the tragus of the ear is level with the sternum. This position improves pulmonary function whilst allowing easier mask ventilation and improving conditions for tracheal intubation (‘sniffing the morning air position’). Pre-oxygenation should be performed as this prolongs the time to desaturation during apnoea.

Ramp position

Tragus level with sternal notch



Head Down (Trendelenburg) Position

In this position, the patient’s head is below the horizontal plane. Obese patients do not tolerate this position. There is an auto transfusion of blood from the lower extremities into the central and pulmonary circulation. The added weight of the abdominal cavity pressing on the diaphragm plus the weight of the chest will further decrease total compliance and functional residual capacity which in turn leads to hypoxia. This position should be avoided or at least the extent of Trendelenburg position should be limited, in morbidly obese patients if possible.

Head up (Reverse Trendelenburg)

Morbidly obese patients should not be allowed to lie supine or completely flat. Their upper body should be elevated 30-45 degree in the semi recumbent position or the table tilted in the reverse Trendelenburg position to allow for adequate ventilation. A head up position results in an uploading of weight of the intra-abdominal contents away from the diaphragm. Morbidly obese patients in this position have an increased pulmonary compliance.

Prone position

Placing a morbidly obese anaesthetised patient in this position is difficult and can be dangerous and hence it should be avoided if possible. Despite this, the prone position is normally well tolerated by obese patients as long as the upper chest and pelvis are adequately well supported to ensure free abdominal movement. The unloading of abdominal viscera significantly reduces pressure on the diaphragm. For very large patients the thorax and pelvis may have to be raised using large pelvic and chest supports. Prolonged surgery in the prone position can cause complications. The arms must be carefully supported to avoid stretching or compressing which can lead to brachial plexus injury.

Lateral Decubitus Position

Due the potential difficulties in positioning the obese patient, procedures which require prone positions are often done in this lateral decubitus position. Morbidly obese patients tolerate the lateral position because their abdominal fat is displaced off the abdomen reducing the intra-abdominal pressure.

Lithotomy Position

In this position, the patient is on their back with the legs and thighs flexed at right angles. In morbidly obese patients positive pressure ventilation with an endotracheal tube is recommended to compensate for the decrease that occurs in lung volume. The longer the patient is in lithotomy position, the greater the chances of developing compartment syndrome. This is due to the heavier weight of the lower extremities. Intermittent pneumatic compression boots will reduce this risk. Backache is also common as is increase in the risk of gastric reflux and pulmonary aspiration.

General Anaesthesia

General anaesthesia in the morbidly obese patient carries a significant risk and discussion with the patient regarding the benefits of the surgery versus the risks of the procedure is appropriate.

As discussed elsewhere the risks include:

Airway – Difficult intubation and facemask ventilation, gastro-oesophageal reflux.

Breathing – Awake, spontaneously breathing obese patients have decreased chest wall compliance and inefficient respiratory muscles. Work of breathing increases with increasing obesity and is associated with increased oxygen consumption and carbon dioxide production. When asleep and supine, the weight of abdominal contents and decreased chest wall compliance leads to difficult spontaneous ventilation and raised ventilator pressures for IPPV. Obese patients require greater diaphragmatic excursion than normal weight

patients to effect the same ventilation. Nasal Hiflow may prolong the safe apnoeic time and therefore may be of benefit for the obese patient.

Circulation – Related to associated cardiovascular disease.

One should aim to give as safe an anaesthetic as possible, taking into account risks and benefits of various procedures. Intubation with an endotracheal tube and the use of short acting agents to minimise post-operative respiratory depression and aid in faster wake up times are beneficial.

An example of an appropriate anaesthetic would be:

If difficult intubation is not expected then pre-oxygenate, GA (rapid sequence induction if reflux present), early use of airway adjuvants or high flow oxygen, endotracheal tube (laryngeal mask airways are inappropriate), Desflurane and Remifentanil infusion, intermittent positive pressure ventilation or pressure support with PEEP, local anaesthetic or regional block.

Desflurane has minimal absorption into fat and therefore fast wakeup time with little or no hangover effect, Remifentanil is appropriate if pain relief is controlled postoperatively with a local anaesthetic or regional block. It has a very short duration of action. Extubate the patient awake, sitting up on the electric bed. The patient should be adequately hydrated throughout the procedure and low molecular weight heparin should be prescribed if not contra- indicated to minimise the risks of thromboembolism.

Due to the higher rate of awareness in obese patients, depth of anaesthesia monitoring should be considered, especially when total intravenous anaesthesia is used in conjunction with neuromuscular blocking drugs.

Reversal of neuromuscular blockade

Neuromuscular monitoring should always be used whenever neuromuscular blocking drugs are used. The use of Sugammadex should be considered in morbidly obese patients where there is a concern about the potential for residual neuromuscular blockade following reversal of NMB drugs.

Extubation Criteria

One should aim for the patient to be in full control of his/her reflexes before extubation. Extubation should occur in a spontaneously breathing, normo-capnic, well oxygenated and awake patient in the sitting position of the electric bed.

Regional Anaesthesia

The use of regional anaesthesia in the obese patient with the concurrent avoidance of general anaesthesia is a safe option. However regional blockade may fail due to the size of the patient. An exit strategy in case a block fails should be decided upon and discussed with the patient pre-operatively. This can include giving a general anaesthetic, using local anaesthetic only (for instance for inguinal hernia surgery) or may involve abandoning the operation altogether.
Appropriate equipment including longer regional block needles and an ultrasound machine should be available. If the anaesthetist does not perform regional anaesthesia regularly it is best practice to request help from a colleague who does.

Spinal anaesthesia may be suitable for operations on the lower limbs and the use of an ultrasound machine can help in the recognition of anatomy that cannot be palpated.

Day Surgery

There are currently no absolute weight limits for patients to be anaesthetised for day case surgery. As such, all patients may be considered for surgery in this area unless deemed unsuitable by a consultant anaesthetist in the pre-assessment clinic.

Post-Operative Care

The morbidly obese patient should be recovered similarly to normal weight patients. Normal monitoring and recovery room procedures should apply. The incidence of post-operative hypoxia, pulmonary embolism and post anaesthetic nausea and vomiting is higher in this group of patients. Special attention should be paid to minimise the risks of hypoxia, hypoventilation and poor patient positioning. Good post-operative pain management is imperative, although care should be taken with long acting opioids. Oxygen should be prescribed as required.

Extra staff may be required to look after the patient in recovery, for example, to help with patient positioning whilst wound and drain inspection is carried out. When the patient is ready for transfer to the ward, the ward staff should be informed and three staff should be utilised for the transfer. Full handover of care should be given including any wound care advice.

Early mobilisation should be encouraged.

References

1. Patel, A. and Nouraei, S. A. R. (2015), Transnasal Humidified Rapid Insufflation Ventilatory Exchange (THRIVE): a physiological method of increasing apnoea time in patients with difficult airways. Anaesthesia, 70: 323–329. doi:10.1111/anae.12923

2. SOBA; The SOBA Single Sheet Guideline. October 2016, Version 2

3. West Suffolk NHSFT; CLINICAL GUIDELINE CG10148-2 Perioperative Management of the Plus Size Surgical Patient

4. Harrogate and District NHSFT; Guidance for the Perioperative Management of the Morbidly Obese Patients

5. The Royal Bournemouth and Christchurch hospitals NHSFT; Clinical Guideline for the Perioperative Management of the Obese Surgical Patient

6. AAGBI/SOBA; Peri-operative management of the obese surgical patient 2015, March 2015.

7. SOBA; Recommendations for screening and management of Sleep Disordered Breathing (SDB) in patients undergoing bariatric surgery. Feb 2016

Appendix 1

THE SOCIETY FOR OBESITY AND BARIATRIC ANAESTHESIA SUMMARY

ANAESTHESIA FOR THE OBESE PATIENT: BMI>35KG/M²

Preoperative Evaluation

S	Snoring: Do you snore loudly (louder than talking or heard through a closed door?	
T	Tired: Do you often feel tired fatigued or sleepy during the daytime?	
O	Observed: Has anyone observed you stop breathing during your sleep?	
P	Blood Pressure: Do you have or are being treated for high blood pressure	
B	BMI: BMI > 35kg/m²	
A	Age: Age > 50	
N	Neck: Neck circumference > 40cm (16 inches)	
G	Gender: Male	

Any of:
Poor functional capacity
Abnormal ECG
Uncontrolled BP/IHD
SpO_2 <94% on air
If Bicarb > 28 OHS Likely
Previous DVT/PE
STOP-BANG>5

→ Yes → Consider:
Blood gases/Sleep Studies
Preoperative CPAP
Echocardiagram
Cardiorespiratory referral

→ Yes → Need experienced anaesthetic team
If major surgery consider HDU

→ No → Maybe suitable as Day case surgery
SEE BELOW

Central Obesity (waist > half height)
Difficult airway /Ventilation problems more likely
Greater risk of CVS disease, thrombosis
↑Risk of Metabolic syndrome:
Central Obesity plus Hypertension
Dyslipidaemia, Insulin resistance

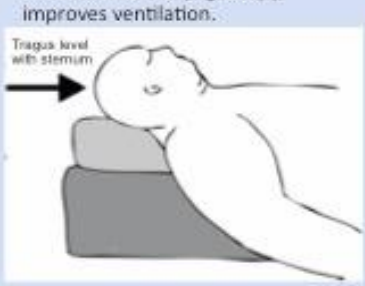
Apple Body Shape vs. Pear Shape Body

Peripheral Obesity
(Fat outside body cavity)
Less co-morbidity

Intra Operative Management

Suggested Equipment
Suitable bed/trolley & operating table
Gel padding, wide strapping, table extensions/arm boards
Forearm cuff or large BP cuff
Ramping device, step for anaesthetist, difficult airway equipment, ventilator capable of PEEP and pressure modes. Hover mattress or equivalent.
Long spinal, regional and vascular needles.
Ultrasound machine.
Depth of anaesthesia and neuromuscular monitoring.
Enough staff to move patient.

Ramping
Ear level with sternum. Reduces risk of difficult laryngoscopy, improves ventilation.



Anaesthetic Technique
Consider premed antacid & analgesia, careful glucose control & DVT prophylaxis.
Self-position on operating table.
Preoxygenate & intubate in ramped position +/- CPAP. Minimize induction to ventilation interval to avoid desaturation. Commence maintenance anaesthesia promptly.
Tracheal intubation is recommended.
Avoid spontaneous ventilation. Use PEEP.
Use short-acting agents e.g. desflurane or propofol infusion, short-acting opioids, multimodal analgesia. PONV prophylaxis.
Ensure full NMB reversal.
Extubate and recover in head up position.

Drug dosing- what weight to use?
Induction agents: titrate to cardiac output- this equates to lean body weight in a fit patient.
Competitive muscle relaxants: use lean body weight.
Suxamethonium use total body weight
Neostigmine: Increase dose. Measure response
Opioids: Use Lean body weight. Care with obstructive apnoea!
TCI propofol: IBW plus 40% excess weight
If in doubt, titrate and monitor effect!

Lean Body Weight this exceeds Ideal body weight in the obese and plateaus =100kg for a man, =70kg for a woman.
Ideal Body Weight in Kg - Broca formula
Men: height in cm minus 100 Women: height in cm minus 105

Suggested dosing regimes for anaesthetic drugs

Lean Body Weight Up to Max-Males 100kg Females 70kg	Adjusted Body Weight Ideal plus 40% excess
Propofol induction	Propofol Infusion
Thiopentone	Alfentanil
Fentanyl	Neostigmine (max 5mg)
Rocuronium	Sugammadex (see package insert)
Atracurium	Antibiotics
Vecuronium	Low Molecular weight Heparin
Morphine	
Paracetamol	
Bupivacaine	
Lidocaine	

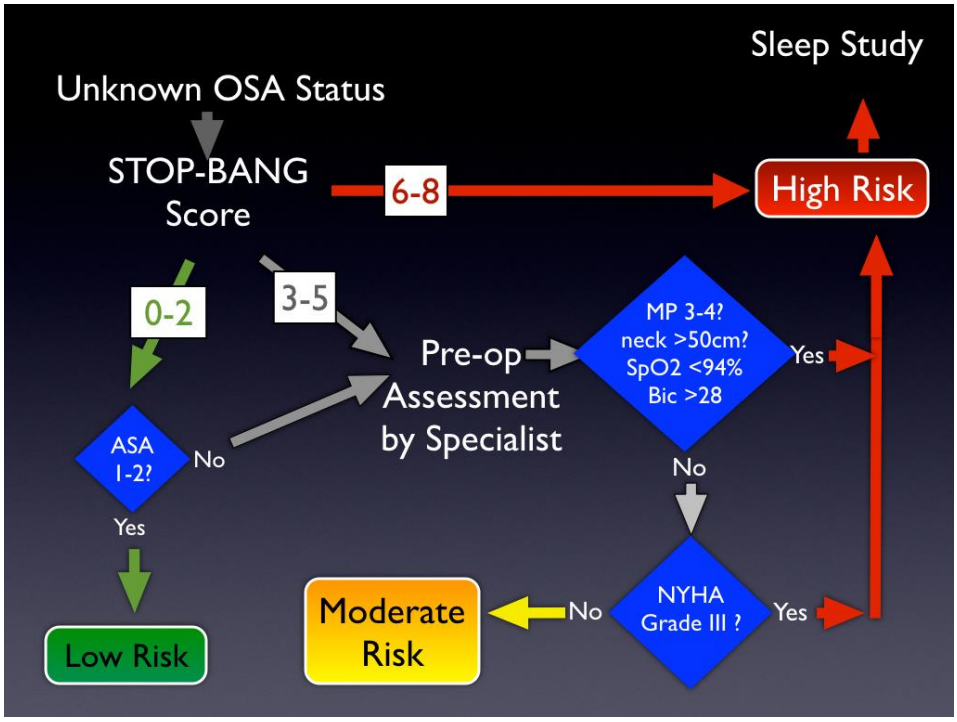
Post Operative Management

PACU discharge: Usual discharge criteria should be met. In addition, SpO_2 should be maintained at pre-op levels with minimal O_2 therapy, without evidence of hypoventilation.
OSA or Obesity Hypoventilation Syndrome: Sit up. Avoid sedatives and post-op opioids. Reinstate CPAP if using it pre-op. Additional time in recovery is recommended, only discharge to the ward if free of apnoeas without stimulation. Patients untreated or intolerant of CPAP who require postoperative opioids are at risk of hypoventilation and require continuous oxygen saturation monitoring. Level 2 care is recommended. Effective CPAP reduces this risk to near normal.
Ward care: Escalation to Level 1, 2 or 3 care may be required based on patient co-morbidity, the type of surgery undertaken and issues with hypoventilation discussed above. General ward care includes: multimodal analgesia, caution with long-acting opioids and sedatives, early mobilisation and extended thromboprophylaxis.

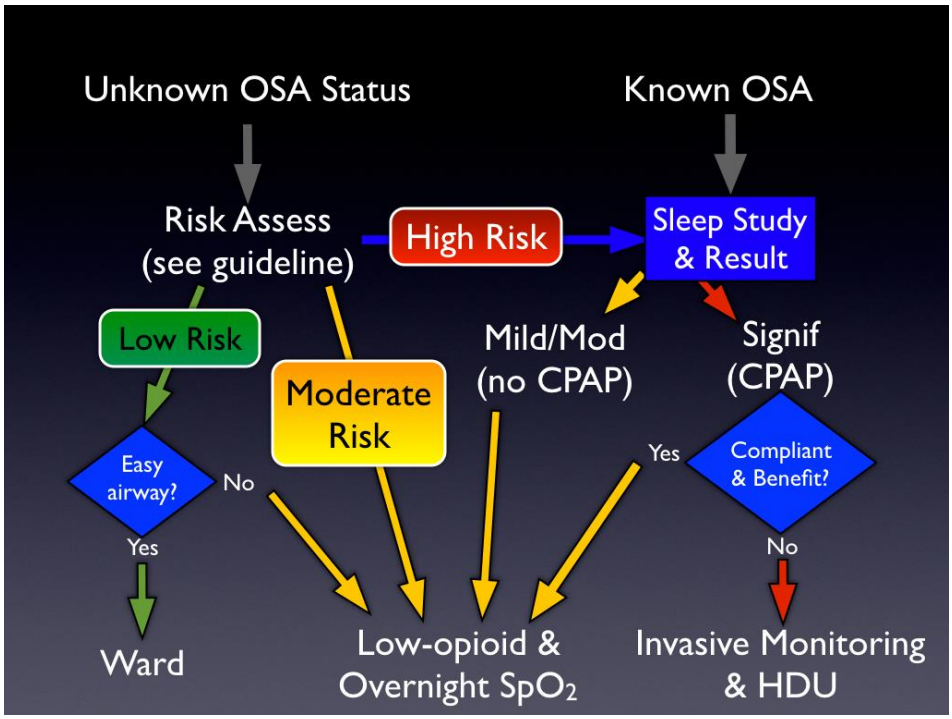
See www.SOBAuk.com for references Sept 2016 v1

Appendix 2

OSA screening algorithm for the obese patient



OSA management algorithm for the obese patient



SOBA; Recommendations for screening and management of Sleep Disordered Breathing (SDB) in patients undergoing bariatric surgery. Feb 2016