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-
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Peri-operative Care of the Obese Patient

Key points:

- **Obesity is growing in prevalence, and presents considerable challenges to anaesthetists.**
- **Careful Pre-Assessment, Intra-operative and Post-operative planning of the obese patient requiring general anaesthesia can help to improve outcomes and reduce risk of anaesthesia.**
- **Obesity Surgery Mortality Risk Score (OSMRS) can be used in addition to other common risk scoring tools to help stratify risk. Patients with Metabolic Syndrome and those who are "apple" shaped are higher risk.**
- **Particular attention must be paid to the safe management of the airway, and ventilation strategy to minimise atelectasis and resulting respiratory complications.**
- **A multimodal approach to analgesia, and multidisciplinary care of the patient in the post-operative period, is required to facilitate early mobilisation and recovery to discharge.**

Introduction:

The World Health Organisation defines Obesity as body mass index (BMI) > 30 kg/m^2. This is then sub-divided into Class I (BMI 30-34.9 kg/m$^{2)}$, Class II (BMI 35-39.9 kg/m^2) and Class III obesity (BMI >40 kg/m^2).

In March 2018 the House of Commons Library published a briefing paper on the UK Obesity Statistics. Obesity levels have increased from 15% to 26% since 1993. 65.7% of men and 57.1% of women are overweight or obese, and 2.9% of all adults are morbidly obese. One in ten children are obese by age 5, and one in five by age 11. In Doncaster, the most overweight local authority, it is estimated that up to 78% of the adult population is overweight or obese (1).

Furthermore the prevalence of obesity in the hospital patient population is undoubtedly higher, as the health risks associated with obesity increases the likelihood of hospital attendance. Obesity is clearly linked to a number of conditions including; Type 2 Diabetes, Hypertension (85% of hypertension is associated with a BMI >25kg/m2), dyslipidaemia, coronary artery disease, stroke, obstructive sleep apnoea and pulmonary hypertension, cancer (10% of cancer deaths among non-smokers are related to obesity, increasing to 30% of endometrial cancers), reproductive dysfunction and osteoarthritis. The "Foresight Tackling Obesities: Future Choices Project" estimates that the cost to the NHS attributed to elevated BMI will be £8.3 billion by 2025, at almost 12% of the NHS budget. (2)

It is clear that as our society becomes more obese, we as anaesthetists, will face greater challenges to provide the safest possible service to the obese patient. I will attempt to summarise current management guidance for the obese patient undergoing anaesthesia; including pre-assessment, intra-operative, and post-anaesthesia care. I will combine this with details of recent updates and current literature.

Anaesthetic Pre-assessment and Risk Stratification:

The aim of the anaesthetic pre-assessment clinic should be to have a two-way conversation with the patient. Explaining the risks associated with the planned procedure, and whether those risks are balanced with the potential benefit of the procedure; i.e. in the patient's best interests. We should be educating our patients, where possible, to be able to make these judgement calls themselves, guided by clinicians. Furthermore, we should take this opportunity to mitigate the risk where possible by optimising any pre-morbid conditions in the timeframe available before surgery. This may be the correct time to delay surgery, or cancel it all together if the risks are deemed too high.

In 2007 DeMaria and colleagues (3) verified the use of the **Obesity Surgery Mortality Risk Score (OSMRS)** to predict mortality in elective bariatric surgery, they indicate that this should be equally applicable to the obese patient undergoing any surgical procedure.

One point is scored for each of the following risk factors:

- BMI >50 kg m^{-2}
- Male Gender

- Arterial Hypertension
- Age >45 yrs
- Presence of risk factors for pulmonary embolism:
    - Previous DVT / PE
    - Pulmonary Hypertension
    - Hypoventilation (Sleep Apnoea or Obesity Hypoventilation Syndrome)
    - Immobility

0-1 points predicts 0.2% 90 day mortality.

2-3 points predicts 1.1% 90 day mortality.

4-5 points predicts 2.4% 90 day mortality.

E. S. Shearer (4) explains how the OSMRS essentially highlights those patients that are likely to have central obesity, be more "apple" shaped, and are more likely to have "metabolic syndrome". Metabolic syndrome consists of dyslipidaemia, hypertension and diabetes, and these patients may be in a chronic inflammatory state with a higher resting C-Reactive Protein (CRP) level.

BMI as a measure of surgical risk is controversial, with a number of papers showing the obesity paradox, whereby increased BMI is shown to be protective, with higher mortality in underweight patients. In 2016, Schumann et al (5) published a review article concluding that obesity is a heterogeneous condition and may be more accurately stratified by presence of comorbidity, metabolic syndrome and abdominal adiposity rather than BMI alone. Also, **extremes of obesity (>40 kgm^{-2})** are more consistently associated with morbidity and mortality rather than BMI 25-40 kgm^{-2}. E. S. Shearer (4) points out that if **waist circumference >88cm in women and >102cm in me**n is used as a measure of obesity rather than BMI, i.e. visceral abdominal obesity "apple", then a greater difference in post-operative outcome can be shown.

Schumann et al (6), in another paper, concluded that **age, BMI, ASA status, surgical duration, open approach, Metabolic Syndrome, obstructive sleep apnoea, asthma, and congestive heart failure** were each independently associated with post-operative pulmonary complications. Metabolic syndrome, in particular, was shown to be a significant risk factor for post-operative pulmonary complications and mortality.

Obesity alone is a significant risk factor for **wound infection, greater surgical blood loss and longer operation time** in general surgical patients (7), while in orthopaedics,

obesity is associated with a **higher mechanical prosthetic failure rate** (8) and **higher prosthetic joint infection rate** (9).

So how should we examine and investigate the obese patient in anaesthetic pre-assessment, once the above risks have been discussed?

1) **Airway:**
   a) Thyromental distance, increasing neck circumference, BMI and Mallampati score of 3 or greater is associated with difficult intubation. (10)
   b) The neck circumference : Thyromental distance ratio >5 is associated with difficult intubation. (11)
   c) Neck circumference of 40cm equates to 5% probability of difficult intubation, whereas a **neck circumference of 60cm** equates to a 35% probability of difficult intubation. (12)
   d) Consider asking patients with beards to shave pre-operatively.

2) **Respiratory:**
   a) The **STOP-Bang** questionnaire (www.stopbang.ca) is useful in the preoperative setting to predict OSA severity, triage patients for further confirmatory testing, and exclude those without disease. (13)
   b) Serum bicarbonate level improves specificity of STOP-Bang screening for obstructive sleep apnoea. (14)
   c) Consider an arterial blood gas if patient has Sats <95% on air; forced vital capacity < 3L or forced expiratory volume in 1 s < 1.5L; respiratory wheeze at rest; or **serum bicarbonate >27mmoll^{-1}**. **PCO_2 >6kPa** indicates a degree of respiratory failure and likely increased anaesthetic risk (15)
   d) Consider referral for sleep studies and introduction of nocturnal CPAP pre-operatively.
   e) For patients already on **nocturnal CPAP** devices, check compliance, and ensure that they know to bring the machine with them on the day of surgery.

3) **Cardiovascular:**
   a) ECG is inexpensive and simple to obtain as a baseline.
   b) Patients with functional capacity greater than **4 METS** and no risk factors (**Revised Cardiac Risk Index**: high risk surgery, ischaemic heart disease, congestive cardiac failure, cerebrovascular disease, insulin dependant diabetes and renal insufficiency) undergoing bariatric surgery are generally considered to be at low risk of cardiovascular complications, and can usually proceed without further investigation. (16) This can be extrapolated to non-bariatric surgery.

c) For patients with recognised cardiovascular disease, ensure compliance optimal medical management.
d) An **ECHO** may be useful to investigate for Cor-Pulmonale and heart failure associated with OSA and obesity.
e) Cardiopulmonary exercise testing (CPET) may help stratify those at high risk of post-operative complications. (17)
f) Patients on regular anti-hypertensive medication will need written advice on which medications to continue or hold in the run up to surgery. i.e. hold ACE inhibitors.

4) Endocrine:

a) Identification of Metabolic Syndrome as an indicator of increased risk.
b) Give detailed instructions for pre-operative diabetes management as per local protocols, and consider referral to the diabetic specialist team in patients with hypoglycaemia unawareness and those with **HbA1c greater than 69 mmol/mol** (8.5%). (18)
c) **Thyroid function tests** as well as routine electrolyte and **renal function** tests may be useful, and abnormalities addressed.

5) Haematological:

a) Identify, evaluate and **treat anaemia**. (19)
b) Patients with previous gastric bypass surgery require testing for coagulation abnormalities associated with chronic vitamin K deficiency, this may also be associated with obesity drugs such as Orlistat.
c) Patients with a history of thrombosis and long-term anticoagulation, or those taking Aspirin or Clopidogrel will need written advice on when to hold medication pre-operatively, and those at high risk will need bridging therapy as per local protocols.

6) Gastrointestinal:

a) Identify oesophageal reflux disease, and ensure optimal treatment in the pre-operative period. Consider a written reminder for patients to take PPI / H2 antagonist on the day of surgery.

Intra-Operative Care:

There are a number of general considerations that should be addressed at the team brief on the day of surgery; check that there is adequate staffing for manual handling of

the obese patient, and that the appropriate equipment is available. Check that the patient is within the weight limits for the operating table and that side extensions and hover mats are available if required. Ensure the availability of high dependency beds for the post-operative period if considered necessary.

For some procedures regional or neuroaxial anaesthesia may be preferential to general anaesthesia, though it is worth bearing in mind that regional and neuroaxial techniques may be technically challenging in the obese patient, and have a higher failure rate. Obese patients with a neuroaxial block may become hypotensive due to aorto-caval compression in a similar manner to the obstetric population, and respiratory mechanics may also be compromised by supine positioning on the table. The use of regional techniques will have the benefit of sparing opioids in the post-operative period, and thus reduce the incidence of opioid related respiratory complications.

For the purpose of this tutorial I will focus on guidelines and advice for general anaesthesia in the obese population:

(1) Monitoring and access:

a) Ultrasound may be required for facilitating peripheral IV access. In challenging cases a second spare cannula should be placed in case of failure, especially when using total intravenous anaesthesia (TIVA).
b) Consider central venous access on a case-by-case basis, guided by difficulty of peripheral access, and expectation of inotropic requirements.
c) Blood pressure cuff may be difficult to size correctly, consider placing the cuff on forearm.
d) An arterial line is justified if the blood pressure cuff is unreliable, or if there are concerns regarding respiratory compromise, i.e. moderate to severe obstructive sleep apnoea.
e) **Neuromuscular monitoring** must be available to confirm reversal of blockade at the end of surgery.

(2) Airway and Induction of Anaesthesia:

a) Ideally allow the patient to position themselves on the theatre table to minimise manual handling.
b) Use the **ramped position**, preferably with a specialised pillow. Having the external auditory meatus in line with the sternal notch has been shown to significantly improve grade of laryngoscopy. (20)

c) Tracheal intubation is highly recommended (15), but be prepared for a difficult airway. Consider a **video laryngoscope** first line, or awake fibreoptic intubation in extreme cases.
d) Optimise pre-oxygenation in order to minimise desaturation during intubation:
    i. **High flow nasal oxygen** has been shown to extend apnoea time and prevent hypoxia. (21)
    ii. Pre-oxygenation with **PEEP of 10cmH_2O** has also been shown to extend time to desaturation. (22)
e) **Propofol** induction should be based on lean bodyweight (23), and this should be titrated to cardiovascular stability. The 5th National Audit Project (NAP5) highlighted obesity as a risk factor for awareness. (24)
f) Use of **Rocuronium** (dosed to Lean Body weight) is preferential to achieve rapid intubating conditions, and a pre-calculated dose of **Sugammadex** should be available.
g) Discuss your airway plan A, B, C, and D with your anaesthetic assistant prior to induction.

(3) Maintenance and Ventilation Strategy:

a) Maintain anaesthesia with **short acting agents**; such as Propofol and Remifentanil TIVA, or Desflurane.
b) TIVA (with Propofol and Dexmedetomidine) has been shown to provide better post-operative recovery, lower pain scores and analgesic requirements, and reduced nausea and vomiting when compared with Desflurane. (25)
c) Consider use of **depth of anaesthesia monitoring**, especially if using TIVA. TIVA/TCI Propofol should be based on adjusted bodyweight (ideal plus 40% excess weight). (23)
d) **10-15 cmH_2O PEEP**, depending on surgical procedure. (22)
e) **Intermittent recruitment manoeuvres** with peak pressure of 40cmH_2O, especially when atelectasis likely. (22)
f) There is limited evidence to suggest benefit of Pressure Control versus Volume Control, but avoid spontaneous ventilation.
g) Limit **tidal volume to 6-8 ml/Kg** based on ideal bodyweight.
h) Avoid plateau pressures greater than 30 cmH_2O where possible.

(4) Emergence and Extubation:

a) Ensure full recovery of **neuromuscular function**, and consider use of Sugammadex.
b) Position the patient **head up** prior to extubation.

c) Controversially, there is some evidence that a lower FiO_2 at extubation may avoid absorption atelectasis; one hour post-operatively, oxygenation had deteriorated in patients given an FiO_2 of 1.0 during emergence but not in patients given an FiO_2 of 0.3. (26)
d) In general, the best practice may indeed include administration of an **FIO of 0.8_2**, rather than 1.0, during emergence from anaesthesia. (27)
e) **Extubate directly to Non-Invasive Ventilatio**n with PEEP >= 10 cmH_2O (22), especially if patient is recognised as having OSA and uses a nocturnal CPAP device.

Post-Anaesthesia Care:

Post-anaesthesia care needs as much attention to detail as the Pre- and Intra- operative period, and our job is not finished when we wheel the patient into the recovery room.

The obese patient may need an extended stay in the recovery room, and discharge only when free of apnoeic episodes. Discharge must be to an appropriate destination, i.e. High Dependency Unit, assessed on a case-by-case basis.

Take extreme care with intra-operative and post-operative opioids, especially in patients with recognised OSA. Use **multi-modal analges**ia to minimise opioids.

Early mobilisation and respiratory physiotherapy has been shown to reduce post-operative pulmonary complications. Interestingly, a single **pre-operative physiotherapy** session has also demonstrated a benefit. (28)

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