

Anaesthetic implications of morbid obesity in pregnancy

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doi: 10.1029/WFSA-D-18-00013

Summary

Obesity is one of the greatest public health challenges of the 21st century. According to World Health Organisation (WHO), the proportion of people in the general population classed as obese has risen by about 10 times since 1980s.¹ Likewise, maternal obesity has mirrored this trend but with some variations between different parts of the world, developed countries being affected more. There are different classes of obesity according to body mass index (BMI): 30 – 34.9kg.m⁻² (class 1); BMI 35 – 39.9kg.m⁻² (class 2); and BMI above 40kg.m⁻² (class 3 or morbid obesity).¹ Maternal obesity is defined as a BMI above 30kg.m⁻² on the first antenatal consultation. In the UK, 20% of pregnant women are classified as obese², 5% have a BMI of greater than 35, 2% greater than 40 and 0.2% greater than 50.³ Obesity during pregnancy puts the mother, fetus and neonate at higher risk of morbidity and mortality during the antenatal, intrapartum and postnatal periods.

COMPLICATIONS OF OBESITY IN PREGNANCY

Obesity in pregnancy is associated with adverse effects on maternal, fetal and neonatal outcomes.^{4,5} Morbid obesity can have an impact on all physiological systems in the pregnant woman (Table 1).

Obese parturients have an increased risk of developing medical complications in pregnancy (Table 2). Some pre-existing medical conditions, such as diabetes and asthma, are prone to get worse or become more resistant to usual therapy.

In addition to the medical complications related to obesity in pregnancy, there are number of obstetric complications which are more common in this group of parturients (Table 2). Peripartum complications, such as perineal trauma, postpartum haemorrhage, cord prolapse, infection, thromboembolism, and uterine rupture are more common in obese parturients.⁷ The rate of emergency caesarean section is significantly higher in the obese group, usually due to protracted labour or failed trial of vaginal delivery post caesarean section.⁴ A study by Wolfe demonstrated a higher failure of induction of labour (29% for morbid obese women and 23% for all obese women) when compared with a failure rate of 13% in women with normal weight.⁶ Studies suggest that obesity results in impaired myometrial contractility and that leptin, which is released by adipose tissue, may contribute to inhibition of uterine contractions.⁸

The fetus of obese women is also at increased risk. There is a higher risk of miscarriage in early pregnancy, preterm labour or fetal demise in later dates.⁴ There is

higher rate of congenital abnormalities. Babies born to obese women are more likely to be macrosomic making shoulder dystocia more common in this group. Stillbirths are substantially higher than the general population (8.6 vs. 3.9 per 1,000 births). The still birth rate increases with increasing BMI (Table 3).³

Obese women, especially morbidly obese ones, are more likely to require anaesthetic input or intervention and hence carry further anaesthetic related complications.

ANTENATAL CARE

Management of maternal obesity should be started before conception. Women should be advised to enter pregnancy with a BMI less than 30kg.m⁻² and ideally less than 25 kg.m⁻². On the first antenatal consultation weight, height and BMI should be recorded and a baseline arterial blood pressure measured. All women with BMI >40kg.m⁻² must be referred for antenatal anaesthetic consultation where potential problems with airway management, neuraxial techniques, venous access, equipment requirements, or co-morbidities will be identified, discussed with the woman and delivery plan documented.⁹ However, it is important to recognise that despite antenatal anaesthetic consultation, many obese women, remain unaware of the risks of obesity in pregnancy.¹⁰ Multi-disciplinary team (MDT) meeting discussion may be necessary in morbidly obese women to allow obstetric, anaesthetic, midwifery and theatres staff

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Table 1. Maternal physiological changes associated with morbid obesity

System	Changes related to morbid obesity
Cardiovascular	<ul style="list-style-type: none"> • Increased blood volume • Increased cardiac output • Hypertension and left ventricular hypertrophy • Increased risk of myocardial ischaemia • Systolic and diastolic dysfunction • Supine hypotension due to higher risk of aorto-caval compression • Pulmonary hypertension and cor pulmonale secondary to obstructive sleep apnoea (OSA)
Respiratory	<ul style="list-style-type: none"> • Reduced FRC • Increased closing capacity • Restrictive respiratory changes due to weight of thoracic adipose tissue • Decreased chest wall and lung compliance • Obstructive sleep apnoea (OSA) • Increased risk of difficult airway • Obesity-related hypoventilation syndrome (Pickwickian syndrome) • V/Q mismatching
Gastrointestinal	<ul style="list-style-type: none"> • Increased risk of regurgitation and pulmonary aspiration (Hiatus hernia and increased residual gastric contents) • Fatty liver infiltration
Renal	<ul style="list-style-type: none"> • Increased angiotensin-converting enzyme and renin levels • Glomerular filtration rate may be reduced • Sodium retention
Endocrine	<ul style="list-style-type: none"> • Peripheral insulin resistance • Increased lipid levels • Dysregulation of sex hormones
Haematological	<ul style="list-style-type: none"> • Pro-coagulable state • Increased risk of thromboembolic diseases • Increased haematocrit due to hypoxia • Reduced immune defence
Musculoskeletal	<ul style="list-style-type: none"> • Poor mobility

to plan for the care of such women and address requirements such as special equipment and manual handling issues. Attempts should be made to seek signs and symptoms of obstructive sleep apnoea (OSA) and, if necessary, appropriate investigations such as sleep studies requested and treatment with CPAP initiated. Consent issues should be discussed with the woman, particularly, with regards to the management of emergency caesarean section for fetal distress which may not be achievable in the time scale which is applicable for women with normal weight.

Parturients with BMI $>35\text{kg.m}^{-2}$ are not suitable for home birth and most of them would not be under midwife-led care.⁹ All women with high BMI should be advised about healthy diet and exercise before and during pregnancy. Professional dietary advice should be sought especially with regards to folic acid and vitamin D supplements.

Thromboembolic risk must be assessed and women at high risk should be prescribed pharmacological thrombo-prophylaxis according to local and national guidelines.¹¹ Continuous screening for hypertensive disorders and gestational diabetes is recommended.

INTRAPARTUM CARE

Morbidly obese women should deliver in a consultant-led obstetric unit with continuous midwifery care. Obesity on its own is not an indication for induction of labour but the presence of co-morbidities may be.⁹ Vaginal delivery is associated with fewer complication rates in this group of parturients, but each case should be taken individually, and a delivery plan should be in place.

ANAESTHETIC MANAGEMENT OF VAGINAL DELIVERY

The anaesthetic team must be involved early in the intrapartum care of morbidly obese women. When a woman presents to labour ward, the duty anaesthetist and theatre team should be made aware. Any antenatal consultations and plans should be reviewed and possibly re-discussed with the team and the woman at the time.

Early venous cannulation is advised as these can prove difficult and are almost always needed for obstetric or anaesthetic reasons. If venous cannulation proves difficult, ultrasound can be used to aid identification of deep veins. In very rare cases, central venous cannulation is required but this is also associated with difficult insertion and increased risk of complications.

Table 2. Maternal, fetal and neonatal risks associated with maternal obesity

Maternal
Higher risk of maternal death
Thromboembolism
Gestational and type 2 diabetes
Hypertension
Pre-eclampsia
Obstructive sleep apnoea
Post-partum haemorrhage
Infections – Wound, urinary tract, genital tract
Increases Caesarean section rate
Increased rate of induction of labour
Higher rate of failed induction of labour
Fetal and neonatal risks
Miscarriage
Preterm labour
Stillbirth
Fetal abnormality such as neural defects and cardiac defects
Fetal distress
Macrosomia
Low Apgar scores

Labour analgesia should be discussed early and epidural for labour advised. There is higher epidural failure rate in morbidly obese patients.¹² As BMI increases, landmarks are more difficult to palpate, and the midline is hard to establish. Positioning the woman for epidural insertion is also challenging due to inability to flex the back. The use of ultrasound to identify the midline, determine the depth to the epidural space and level of lumbar spines is recommended as it has been demonstrated to reduce the number of attempts and increase the success rate.¹³ Longer needles may be needed but are not always available. Once the epidural catheter is sited, it is important to carefully sit the woman prior to fixation of the epidural catheter to prevent withdrawal of the catheter from the epidural space. Increased mobility of the skin and fat can cause displacement of the epidural catheter during any movement in labour. It is therefore essential to leave increased length of epidural catheter in the epidural space and to monitor the epidural closely during labour.

Combined spinal-epidural (CSE) is used for labour analgesia in some units but it may not always be a feasible option due to lack of long enough pencil-point needles. Continuous spinal analgesia can be offered, especially when accidental dural puncture occurs.¹⁴ The use of an intrathecal catheter in labour requires close monitoring by an anaesthetist. The intrathecal catheter can be used to top up for operative delivery or other procedures.

Patient controlled intravenous analgesia (PCA) with opioids (remifentanyl, fentanyl, morphine) is not advisable in morbidly obese women because of the risks of respiratory depression and sedation. Many women with BMI >40kg.m⁻² have OSA and/or obesity related hypoventilation. Opioid administration will exacerbate hypoventilation and increase the incidence of apnoea, leading to

Table 3. Rates of still births in relation to BMI.³

BMI (kg/m²)	Still births (per 1000 births)
35 – 39.99	7.9
40 – 49.99	8.8
>50	15.8

prolonged hypoxic episodes. This is detrimental to the mother, as well as to the fetus. In addition to the physiological side effects of opioids, pharmacokinetic and pharmacodynamic considerations exist. The dosing regimen should be based on lean body weight. Most PCA pumps have limitations of their pharmacokinetic models when high weights are used, making dosing of drugs unreliable, unsafe, or inadequate.

Active management of third stage of labour is recommended because of the increased likelihood of postpartum haemorrhage. Cross-matched blood should be available and administered early if required. Uterotonic agents, such as syntocinon, should be used as a bolus and an infusion. Care with ergometrine should be taken, as there is higher chance that obese women are hypertensive or pre-eclamptic.

ANAESTHESIA FOR CAESAREAN SECTION

Unless there are contraindications, neuraxial anaesthesia remains the preferred modality of anaesthesia for caesarean section in morbidly obese parturients because general anaesthesia is associated with increased maternal mortality and morbidity.¹⁵

REGIONAL ANAESTHESIA

Epidural top up

In cases where an indwelling epidural catheter has been working well for labour analgesia, epidural top up is the safest and perhaps quickest anaesthetic technique. Epidural top ups in the obese parturients should be carefully titrated and thorough check of the sensory block undertaken. Maximum doses of local anaesthetics should be calculated according to Ideal Body Weight (IBW). Volumes required may be lower than expected due to increased pressure in the epidural space and higher content of adipose tissue. Epidural opioids should be used to augment the block and to prolong analgesia in the postoperative period. The same precautions with epidural opioids should be considered as with intravenous ones. Long-acting opioids, such as diamorphine or morphine, may necessitate HDU care for close monitoring and possibly non-invasive ventilation (in some case of severe OSA). The advantages of a good working epidural catheter are that it can be topped up if required should surgery be prolonged, it can be used for postoperative analgesia or it can be topped up again should further operative procedure be required in the postoperative period.

Early mobilisation should be encouraged to reduce the risk of thromboembolic events. If mobilisation is delayed, intermittent compression devices should be used until the woman is mobilising.

Single-shot spinal anaesthesia

Single-shot spinal anaesthesia (SSSA) is a procedure that most anaesthetists are familiar with and it provides reliable block with a rapid onset. It, therefore, makes it a reasonable option when faced

with an urgent caesarean section for a morbidly obese parturient. However, there are some drawbacks to using a SSSA in morbidly obese women. The need for a longer needle may make the introducer needle inadequate for the long spinal needle. This can lead to more failed attempts causing delays and distress. Some authors suggest using a Tuohy needle as an introducer in the morbidly obese patients as it leads to fewer attempts in establishing anaesthesia.¹⁶ A second drawback is the inability to top up should surgery be prolonged. In this case, conversion to general anaesthesia (GA) remains the only rescue option. Conversion to general anaesthesia intraoperatively in morbidly obese woman can be challenging and can present the anaesthetist with a dilemma should failed intubation occur. The third drawback is the inability to titrate the spinal dose. There is no evidence that reduction in doses of intrathecal local anaesthetics is required in morbidly obese women.¹⁷ However, because of the increased risk of aorto-caval compression, morbidly obese patient may develop severe catastrophic post spinal hypotension.¹⁸

Combined spinal-epidural anaesthesia

Combined spinal-epidural anaesthesia (CSE) is the preferred neuraxial technique for morbidly obese parturients. It provides reliable anaesthesia with a rapid onset (spinal component) and the ability to extend the duration and the level of the block as required (epidural component). Other advantages of a CSE are the ability to give a lower spinal dose and to extend the block using the epidural catheter. This technique is also preferred in cases where opioids are considered higher risk such as patients with severe OSA because anaesthesia can be extended by epidural top ups with local anaesthetics. Disadvantages of CSEs include: possible failure to pass the epidural catheter, a slightly higher failure rate of the spinal component and the usage of an untested epidural catheter.

Continuous spinal anaesthesia

This technique is rarely used as a primary anaesthetic plan, but there are suggestions that it should be considered more. It is usually employed in cases where an intrathecal catheter has been used for labour analgesia or an attempt at an epidural or CSE has produced a dural puncture.¹⁴ Intrathecal catheters should be managed very carefully, and local anaesthetic injected very slowly and with limited volumes. The risk of high spinal anaesthesia or total spinal anaesthesia is high in these cases. High spinal block is highly undesirable in the obese population as hypoventilation is more profound and leads to more pronounced hypoxaemia.

The use of continuous spinal anaesthesia is also limited by the higher risk of post-dural puncture headache (PDPH), despite the protective function of an indwelling catheter. There are suggestions that obese patient is at a lower risk of developing PDPH, but this is controversial.^{19, 20}

Double catheter technique

In certain cases of parturients with extremely high BMI a midline laparotomy is performed instead of horizontal (Pfannenstiel) incision. Anaesthesia and analgesia provided by a lumbar epidural would not be sufficient in these patients. There are several cases reports of simultaneously using two epidural catheters – lumbar and low thoracic levels.^{21, 22} This is an option which needs appropriate

planning and is probably applicable to only few super morbidly obese parturients.

GENERAL ANAESTHESIA

General anaesthesia in morbidly obese parturients is usually reserved for the emergency situations and instances where neuraxial techniques are contraindicated or have failed. It is also sometimes the only option when faced with non-obstetric surgery.

Antacid Premedication

Morbid obesity is associated with increased risk of regurgitation and aspiration. It is therefore important that antacid prophylaxis using H₂-blockers and sodium citrate are used appropriately in these patients.

Positioning

Positioning on the operating table of a morbidly obese pregnant woman can prove to be a challenge. A compromise between left lateral tilt, appropriate position for airway management, and patient's comfort, needs to be achieved. Elevating the woman's torso in the head up ramped position improves ventilation and laryngoscopy views and reduces reflux symptoms. Aligning the tragus and the sternal notch improves airway management. Ramping position can be achieved by using head elevating laryngoscopy aids such as the Oxford Head Elevating Laryngoscopy Pillow HELP® or by using multiple pillows under the patient's torso until an elevated desirable position is achieved.

Operating tables have limits on the weight they can sustain safely. This needs to be checked prior to positioning. Extra theatre staff is necessary to help with manual handling, especially when hoists are not available.

Monitoring

Monitoring requirements for the morbidly obese patient should comply with the AAGBI monitoring standards.²³ However, additional monitoring may be necessary in women with severe comorbidities or women where non-invasive monitoring is inadequate. It is important to use appropriately sized blood pressure cuff in order to have accurate measurements. In some instances, invasive blood pressure monitoring may be the only option to have reliable measurements. Transabdominal fetal monitoring may prove difficult or impossible due to the large size of abdominal fat.

Anaesthetic drugs

Administration of anaesthetic drugs in morbidly obese patients requires careful understanding of the altered pharmacodynamics and pharmacokinetics. Incorrect calculations can lead to overdosing or under dosing. Total body weight (TBW) should be used for suxamethonium, lean body weight (LBW) should be used for drugs such as thiopentone, propofol and opioids and ideal body weight (IBW) - for drugs such as non-depolarising muscle relaxants, paracetamol and non-steroidal anti-inflammatory drugs. Historically, the induction agent of choice in obstetrics in the UK has been thiopentone but there has been a recent change to using propofol following the publication of the DAS/OAA obstetric difficult airway guidelines and the 5th National Audit Project (NAP5)²⁴ results.

Thiopentone was identified as a risk factor for accidental awareness under general anaesthesia as a result of inappropriate dosing (especially in the obese), short duration of action and infrequent use in non-obstetric cases.²⁴ Propofol has many advantages such as familiarity, less confusion with other drugs, does not need mixing and drawing up in advance and produces better intubating conditions.

Rapid sequence induction (RSI) is almost universally employed in obstetric anaesthesia. Short acting muscle relaxant producing deep paralysis rapidly is ideal in these situations. In the morbidly obese parturients difficult airway is more likely and paralysis needs to be short or reversible to make intubation attempts safe. Succinylcholine is the classic muscle relaxant used in a dose of 2 – 2.5mg.kg⁻¹ total body weight (TBW). Obesity and pregnancy reduce pseudocholinesterase levels and this makes the duration of action of succinylcholine unpredictable in some cases. After the introduction of sugammadex, there has been a slow but gradual change to using rocuronium for RSI in obstetrics in a dose of 1 – 1.2mg.kg⁻¹ IBW. It produces adequate intubating conditions within 30 seconds and is comparable to succinylcholine. Unfortunately, sugammadex is still an expensive drug and is not always readily available; hence the slow change in practice. Immediate reversal of high-dose rocuronium paralysis is achieved by 16mg.kg⁻¹ IBW of sugammadex. However, in this situation, it is easy to develop a false sense of security as reversal of muscle relaxant does not necessarily produce a clear airway.

Maintenance of anaesthesia in morbidly obese patients is largely achieved by inhalational agents, such as sevoflurane or desflurane which have shorter recovery times compared with isoflurane.

Airway management

General anaesthesia (GA) in morbidly obese patients is associated with significant morbidity and mortality. Three out of four obstetric difficult airway cases in the Fourth National Audit Project (NAP4) were obese.²⁵ The physiological changes of pregnancy exacerbate the difficulties encountered when managing the airway in the obese patient. Therefore, general anaesthesia in morbidly obese parturient requires detailed airway assessment, careful planning and preparation, and communication with the team prior to induction of GA. Airway assessment should encompass prediction of: difficult tracheal intubation, mask ventilation, supraglottic device insertion and front-of-neck access. Neck circumference is a useful predictor of difficult intubation, mask ventilation and front-of-neck access. Ultrasound of the neck can be used to identify the cricothyroid membrane prior induction of GA in case failed tracheal intubation occurs and front-of-neck access is required.

In cases of super morbidly obese, an awake intubation using either a fiberoptic scope or rigid laryngoscope may be chosen as the safest airway management prior to induction of general anaesthetic.¹⁴

In 2015, the Difficult Airway Society (DAS) produced algorithms for airway management specific to obstetrics (see Figure 1 and Figure 2).²⁶ The main emphasis in these guidelines are planning and preparation, as well as communication with the whole team. Prior to induction of GA, the team should decide whether the patient should be woken up or surgery proceed, should failed intubation occur. This can be done using Table 1 of the DAS/OAA guidelines (Figure 2).

Figure 1. Safe Obstetric general anaesthetic algorithm – reproduced with permission from the Difficult Airway Society and Obstetric Anaesthetic Association.²⁶

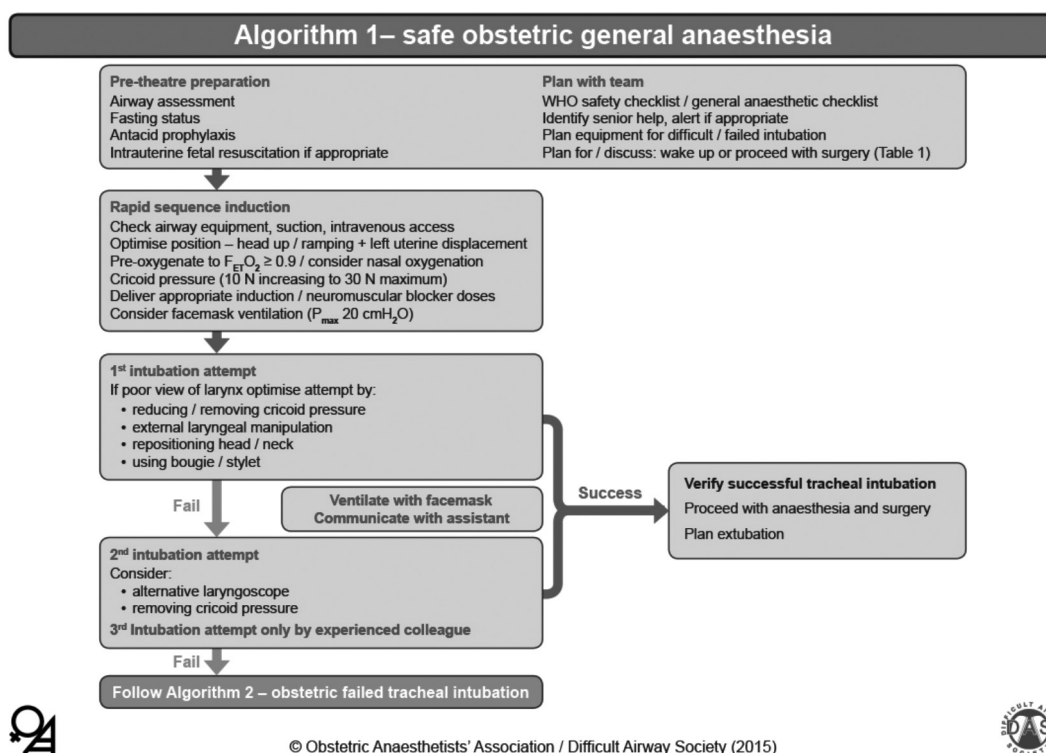


Figure 2. Decision whether to proceed or wake following failed tracheal intubation- reproduced with permission from the Difficult Airway Society and Obstetric Anaesthetic Association.²⁶

		Table 1 – proceed with surgery?			
Factors to consider		WAKE	←————→	PROCEED	
Before induction	Maternal condition	• No compromise	• Mild acute compromise	• Haemorrhage responsive to resuscitation	• Hypovolaemia requiring corrective surgery • Critical cardiac or respiratory compromise, cardiac arrest
	Fetal condition	• No compromise	• Compromise corrected with intrauterine resuscitation, pH < 7.2 but > 7.15	• Continuing fetal heart rate abnormality despite intrauterine resuscitation, pH < 7.15	• Sustained bradycardia • Fetal haemorrhage • Suspected uterine rupture
	Anaesthetist	• Novice	• Junior trainee	• Senior trainee	• Consultant / specialist
	Obesity	• Supermorbid	• Morbid	• Obese	• Normal
	Surgical factors	• Complex surgery or major haemorrhage anticipated	• Multiple uterine scars • Some surgical difficulties expected	• Single uterine scar	• No risk factors
	Aspiration risk	• Recent food	• No recent food • In labour • Opioids given • Antacids not given	• No recent food • In labour • Opioids not given • Antacids given	• Fasted • Not in labour • Antacids given
	Alternative anaesthesia • regional • securing airway awake	• No anticipated difficulty	• Predicted difficulty	• Relatively contraindicated	• Absolutely contraindicated or has failed • Surgery started
After failed intubation	Airway device / ventilation	• Difficult facemask ventilation • Front-of-neck	• Adequate facemask ventilation	• First generation supraglottic airway device	• Second generation supraglottic airway device
	Airway hazards	• Laryngeal oedema • Stridor	• Bleeding • Trauma	• Secretions	• None evident

Criteria to be used in the decision to wake or proceed following failed tracheal intubation. In any individual patient, some factors may suggest waking and others proceeding. The final decision will depend on the anaesthetist's clinical judgement.
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Morbid obesity favours the waking of the patient because proceeding with surgery with an unsecured airway carries a high risk of maternal hypoxia. Pre-oxygenation is recommended prior to induction of GA in all patients, but in particular during RSI. However, despite good pre-oxygenation with face mask, pregnant women desaturate rapidly, and obese pregnant women desaturate even faster. The new guidelines recommend the use of nasal oxygenation to administer oxygen during apnoea in order to increase the safe apnoea time. Nasal cannula at 5 – 15L/min have been shown to be effective in reducing hypoxia during instrumentation of the airway.²⁷ High flow humidified nasal oxygen using systems, such as Optiflow, have been used recently and shown to increase the safe apnoea time in obstetrics.²⁸ Videolaryngoscopes increase successful rate of intubation and should therefore be available and be used in obese women.

A significant proportion of airway related complications arise during emergence of anaesthesia. Morbidly obese patients are prone to slower emergence and extubation should be carefully planned and performed according to the DAS extubation guidelines.²⁹ The morbidly obese woman falls into the high risk extubation group and should have tracheal extubation performed with the woman fully awake and in a ramped position.

Postoperative care and analgesia

Postoperative analgesia following general anaesthesia is a challenge in the morbidly obese parturient. Multimodal pain management is advised – regional techniques are favoured in order to reduce the need for systemic opioids. Local infiltration with local anaesthetics or transverse abdominal plane (TAP) blocks performed by either the

anaesthetist under ultrasound guidance or the obstetrician provide significant pain relief and lead to less opioid usage. Paracetamol and non-steroidal anti-inflammatory drugs, where not contraindicated, reduce opioid consumption significantly. Certain analgesics, such as codeine, should be avoided in women who are breastfeeding.

Close post-operative monitoring of morbid obese women in an HDU setting is important in order to prevent avoidable complications such respiratory depression. Precautions against DVT should take place and appropriate doses of thrombo-prophylaxis administered.

CONCLUSION

Obesity in the obstetric population continues to grow and present challenges to all healthcare workers. Morbid obesity increases morbidity and mortality in pregnant women and their babies. Careful planning and preparation in the antenatal, intrapartum and postnatal periods is necessary in order to ensure safe outcomes for the mother and baby. Regional analgesia and anaesthesia are recommended in order to avoid the risks of general anaesthesia. Should general anaesthesia be required, careful team planning, preparation and performance by experienced staff is essential.

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