Wairarapa DHB
Wairarapa District Health Board

Patient Acceptance for Anaesthesia	
Type: Guideline	**HDSS Certification Standard** [optional]
Issued by: Anaesthesia Advisor	**Version:** 1
Applicable to:	**Contact person:** Leona Wilson

Purpose:

- To place safe limitations on patients accepted for anaesthesia within Wairarapa Hospital and reflect the capabilities and equipment available.

Guideline content

The limitations placed on patients accepted for anaesthesia within Masterton Hospital are as follows:

- No patient under 3 years of age
- No patients with a BMI >45
- No obstetric patients with a BMI >40 at booking
- No patients of ASA 4 and 5 class, or complex ASA3 patients (ie no patients with significant co-morbidities relevant to anaesthesia)
- No patients who will require ICU post-operatively

Exceptions to the above are as follows:

- Patients suffering from fractured neck of femur who are ASA 4, provided that:
  - The surgeon and anaesthetist agree that it is a palliative procedure for that patient
  - The person giving consent accepts the limitation on post-operative management consequent on operation at Masterton Hospital. (this exception takes specific note of the issues with transferring an elderly patient with a significant fracture)

Process to be followed:

Referral by clinician with primary responsibility to clinician at neighbouring DHB: this will take into account the needs related to:

- Mode of transfer (no helipad at Hutt)
- Management of significant co-morbidities eg renal dialysis

INTER-DHB TRANSFER FOR MATERNITY WOMEN WITH INCREASED BMI

The risk of pregnancy complications increases proportional to maternal weight. Other clinical factors may compound the risk or sometimes ameliorate it. Obstetric and, when appropriate, multi-disciplinary consultation will attempt to assess total risk and identify high-risk women requiring delivery at Hutt Hospital. Psycho-social issues, specific resource availability and the risk of transfer in labour will also be considered. Because of the complexity this document is regarded as a guideline to inform practice which will require individualisation and modification as new clinical issues arise.

Increased Obstetric Risk with booking BMI>35
Pre-eclampsia 5x
Macrosomia 4x
Shoulder dystocia 3x
Stillbirth 3x
Caesarean section 3x
Low Apgar scores 2x
Post-partum haemorrhage
Instrumental delivery
Birth defect (cardiac, GI, CNS, orofacial cleft)
Venous thromboembolism
Post-partum sepsis
Operative delivery blood loss
Difficult fetal surveillance (ultrasound/CTG)

Increased Anaesthetic Risk with booking BMI>35
Difficult airway
Difficult/unsatisfactory epidural analgesia
Failed intubation
Gastro-oesophageal reflux
High spinal
Supine-hypotension syndrome
Cardiac dysfunction
Hypoxaemia/Rapid desaturation

Institutional limitations (Wairarapa Hospital)
No anaesthetic interns
No intensive care facilities
Limited scope of practice
No obstetric interns
On-call theatre staff

Risks of inter-DHB transfer
Disrupted continuity of care
Unsupervised labour and delivery
Psychological/emotional stress
Social isolation (friends/family)
Financial burden

Other issues
Women's choice
Fully informed consent

Best practice recommendations and medico-legal concerns

GUIDE FOR Lead Maternity Carer (LMC)

Follow Referral Guidelines for Obstetric consultation and transfer of care. Refer women with a BMI of 35 or more.
Explain rationale for Obstetric consultation and delivery at another hospital.
Provide information leaflet.
Refer to secondary care antenatal clinic with appropriate documentation

Advise as follows:
Booking BMI>35-39.9: *Delivery at Wairarapa Hospital is likely unless there are other important risks in addition to the high BMI.*

Booking BMI>40-44.9: *Delivery at Hutt Hospital is likely to be recommended. If the high BMI is the only risk factor, further discussion with an anaesthetist will determine safety for delivery at Wairarapa Hospital.*

Booking BMI>45: *Delivery at Hutt Hospital will be recommended*

Woman refuses plan

Recommend Obstetric consultation to clarify risk and establish management plan.
If woman refuses Obstetric consultation, follow Referral Guidelines (Section 5)

Plan for transfer of care

Following consultation, the Obstetrician will send a referral letter to the Obstetric Department, Hutt Hospital.
Obstetric Department, Hutt Hospital will, as a minimum, book the woman into their service at about 30 weeks and review at 36 weeks to determine the plan for labour.
Antenatal care with the local LMC will continue
The woman will keep her own updated case notes
There will be an appropriate plan between the woman and LMC for notification of, and transport in, early labour
The LMC will notify Hutt Hospital Maternity Unit that the woman is in labour and likely time of arrival.

Early labour problems

If there is sufficient clinical concern, acute Obstetric and Anaesthetic assessment should be sought at Wairarapa Maternity Unit to determine further management

GUIDE FOR OBSTETRICIAN

Use Referral Guideline 'transfer of care' recommendations as approximate guide to additional risk factors

Booking BMI>35-39.9: *Delivery at Wairarapa Hospital is likely unless there are other important risks in addition to the high BMI.*
Assess additional risk factors to determine total risk
If there are specific concerns, the On-call Anaesthetist will attend the clinic on request to provide further assessment

Booking BMI>40-44.9: *Delivery at Hutt Hospital is likely to be recommended. If the high BMI is the only risk factor, further discussion with an anaesthetist will determine safety for delivery at Wairarapa Hospital.*
Assess additional risk factors to determine total risk
If the woman is otherwise low risk, the On-call Anaesthetist will attend the clinic on request to provide further assessment

Booking BMI>45: *Delivery at another hospital will be recommended*
Explain rationale for delivery at another hospital.
Explain process of inter-DHB transfer and plan for continuing antenatal care

Method for inter-DHB transfer
Letter to 'Obstetric Unit, Hutt Hospital'
Include relevant notes e.g. booking details, progress sheet
Ensure LMC is included in correspondence
Establish clear local plan for further antenatal care
Advise woman to contact her LMC in early labour or if problems
Advise woman to establish a plan for transport in labour

Wairarapa DHB
Wairarapa District Health Board
Te Poari Hauora a-rohe o Wairarapa

Women with a raised BMI in pregnancy: Patient Information Leaflet

Wairarapa Hospital provides for a wide range of health services but with some limitations. Having an increased BMI can increase the risk for problems in a pregnancy and the birth. If at your first visit with your Lead Maternity Carer (LMC) the BMI is over 35 a consultation with an Obstetrician; and an anaesthetist if necessary, will be arranged before 26 weeks to discuss any risks and look at the safest place for delivery. A small number of women with a BMI over 45 are at high risk and will be advised to deliver at Hutt Hospital.

What are the Increased risks for women whose BMI is 35 or over?

The reason why clinicians advise women with an increased BMI to deliver their baby at Hutt Valley Hospital is because the risk associated with delivery increases with a higher BMI and Hutt Valley DHB is better equipped to support the mother. Wairarapa Hospital is a rural hospital which does not have the full facilities that Hutt Valley DHB has. This means there are limitations to what is done in Wairarapa Hospital. Wairarapa hospital does not have intensive care facilities, we have limited facilities for very-unwell mothers and/or babies; we do not have resident anaesthetic or obstetric doctors and only have on-call theatre staff to provide services after hours.

The obstetric risks for women with a BMI over 35 include:

- High blood pressure and pre-eclampsia
- Difficult monitoring of babies during pregnancy and labour
- Large babies and difficult birth
- Caesarean section and instrumental delivery
- Bleeding, infection, thrombosis (blood clots) following delivery
- Stillbirth

In addition to the above, there are also increased anaesthetic risks for pregnant women with a BMI over 35. Those risks include:

- Difficult and/or unsatisfactory epidural analgesia
- Difficult airway, failed intubation and stomach acid reflux
- High spinal anaesthesia-associated with low Blood Pressure and reduced oxygen delivery

How will I know if I have a high BMI?

Your midwife will weigh you and measure your height at the first pregnancy visit to establish your Body Mass Index (BMI). Your midwife will refer you to Wairarapa Hospital antenatal clinic if she identifies a BMI of 35 or more or any other significant risk. This appointment will usually be arranged before 26 weeks of your pregnancy

What will happen if my BMI is over 35?

At the antenatal clinic an Obstetrician will assess your risk and discuss this with you, your LMC and if necessary an anaesthetist.

If your BMI is between 35 and 39.9 the Obstetrician is likely to recommend a delivery at Wairarapa Hospital, unless there are other important risks in addition to the high BMI (e.g. Diabetes that is not well controlled).

Wairarapa DHB
Wairarapa District Health Board
Te Poari Hauora a-rohe o Wairarapa

If your BMI is between 40-44.9 and the high BMI is the only risk factor, a further consultation with an Obstetrician and an Anaesthetist will need to occur to determine safety for delivery at Wairarapa Hospital.

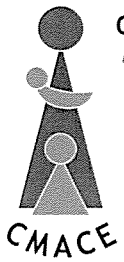
If you BMI is greater than 45 you will be referred Hutt Hospital to deliver your baby.

How will the referral be made?

If following your consultation with the Obstetrician and Anaesthetist it is decided you need to deliver your baby at Hutt Valley DHB to the following process will be followed:

- The Obstetrician will write to Hutt Hospital to arrange a clinic appointment.
- You will continue usual pregnancy care with your local midwife
- You will be asked to visit the Hutt Hospital Antenatal Clinic at 30 weeks to book in and again at 36 weeks to establish a plan for transfer and delivery. If you have any questions or concerns around this process, please contact your local LMC
- Contact your local midwife when in early labour and confirm the plan for transfer to Hutt Hospital Delivery Suite.
- If there are no major problems after delivery, you will be transferred back to Wairarapa Hospital or home. Following your delivery postnatal care will occur with your local LMC.

4



Centre for Maternal and Child Enquiries
Improving the health of mothers, babies and children

Royal College of Obstetricians and Gynaecologists

Setting standards to improve women's health

CMACE/RCOG Joint Guideline

Management of Women with Obesity in Pregnancy

March 2010

This guideline was produced on behalf of the Centre for Maternal and Child Enquiries and the Royal College of Obstetricians and Gynaecologists by:

J Modder MRCOG, CMACE and KJ Fitzsimons Ph.D, CMACE

and reviewed by the RCOG Guidelines Committee.

The final version is the responsibility of both CMACE and the Guidelines Committee of the RCOG. Updates of this guideline will be the responsibility of the Guidelines Committee of the RCOG.

DISCLAIMERS

CMACE ACKNOWLEDGEMENTS AND DISCLAIMER

This work was undertaken by the Centre for Maternal and Child Enquiries (CMACE) as part of the CEMACH programme. The work was funded by the National Patient Safety Agency; the Department of Health, Social Services and Public Safety of Northern Ireland; NHS Quality Improvement Scotland (NHS QIS); and the Channel Islands and Isle of Man. The views expressed in this guideline do not necessarily represent the views of the funding bodies.

The recommendations contained in this guideline represent the view of CMACE, the CMACE Obesity Consensus Standards Group and the RCOG Guideline Committee. They do not override healthcare professionals' individual responsibility to make appropriate decisions in the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

RCOG DISCLAIMER

The Royal College of Obstetricians and Gynaecologists produces guidelines as an educational aid to good clinical practice. They present recognised methods and techniques of clinical practice, based on published evidence, for consideration by obstetricians and gynaecologists and other relevant health professionals. The ultimate judgement regarding a particular clinical procedure or treatment plan must be made by the doctor or other attendant in the light of clinical data presented by the patient and the diagnostic and treatment options available within the health services available.

This means that RCOG Guidelines are unlike protocols or guidelines issued by employers, as they are not intended to be prescriptive directions defining a single course of management. Departure from the local prescriptive protocols or guidelines should be fully documented in the patient's case notes at the time the relevant decision is taken. Once adapted for local use, these guidelines are no longer representative of the RCOG.

The Guidelines review process will commence in 2013
unless otherwise indicated

Jointly published by the Centre for Maternal and Child Enquiries and the Royal College of Obstetricians and Gynaecologists.

CMACE is a Company Limited by Guarantee. Registered in England and Wales No. 6610301.

CMACE Registered Charity No. 1128873

RCOG Registered Charity No. 213280

Centre for Maternal and Child Enquiries
Improving the health of mothers, babies and children

Royal College of Obstetricians and Gynaecologists
Setting standards to improve women's health

CMACE/RCOG JOINT GUIDELINE
MANAGEMENT OF WOMEN WITH OBESITY IN PREGNANCY

1. Purpose and scope

Maternal obesity has become one of the most commonly occurring risk factors in obstetric practice. Obesity in pregnancy is usually defined as a Body Mass Index (BMI) of 30 kg/m^2 or more at the first antenatal consultation. BMI is a simple index of weight-for-height and is calculated by dividing a person's weight in kilograms by the square of their height in metres (kg/m^2). There are three different classes of obesity: BMI 30.0–34.9 (Class I); BMI 35.0–39.9 (Class 2); and BMI 40 and over (Class 3 or morbid obesity),[1,2] which recognise the continuous relationship between BMI and morbidity and mortality.[2]

While the majority of the recommendations within this guideline pertain to women with a BMI ≥30, some recommendations are specific to women in the higher classes of obesity only. Obese women with a BMI below the threshold specified may also benefit from the particular recommendation; however, the chosen BMI cut-offs reflect careful consideration given to the balance of medical intervention versus risk, differences in local prevalence of maternal obesity, and resource implications for local healthcare organisations. Local maternity services may wish to implement these standards for all women with maternal obesity after consideration of these issues.

The recommendations cover interventions prior to conception, during and after pregnancy.

This guideline does not address the following areas: Management of pregnancy following bariatric surgery; anti-obesity drugs in pregnancy; technique and frequency of ultrasound scanning; gestational weight gain; dietary and exercise advice; and postnatal contraception. The National Institute for Health and Clinical Excellence (NICE) is currently developing a guideline on Weight Management in Pregnancy and after Childbirth. The guideline is due to be published in July 2010 and will cover dietary and physical activity interventions and monitoring weight.

2. Background and introduction

The prevalence of obesity in the general population in England has increased markedly since the early 1990s.[3] The prevalence of obesity in pregnancy has also been seen to increase, rising from 9–10% in the early 1990s to 16–19% in the 2000s.[4,5]

Obesity in pregnancy is associated with an increased risk of a number of serious adverse outcomes, including miscarriage,[6] fetal congenital anomaly,[7] thromboembolism,[8,9] gestational diabetes,[10] pre-eclampsia,[11] dysfunctional labour,[12] postpartum haemorrhage,[10] wound infections,[10] stillbirth[13,14] and neonatal death.[14-16] There is a higher caesarean section rate[17] and lower breastfeeding rate[18] in this group of women compared to women with a healthy BMI. There is also evidence to suggest that obesity may be a risk factor for maternal death: the Confidential Enquiry into Maternal and Child Health's report on maternal deaths in the 2003–2005 triennium showed that 28% of mothers who died were obese,[19] whereas the prevalence of obesity in the general maternity population within the same time period was 16-19%. [4,5]

3. Methodology

This CMACE/RCOG guideline is based on standards of care developed as part of a national enquiry project on Obesity in Pregnancy conducted by the Centre for Maternal and Child Enquiries (CMACE) and funded by the National Patient Safety Agency and by contributions from all the UK nations. The development of standards included searching for and preparing scientific evidence, consulting with stakeholders, establishing an expert multidisciplinary group, and developing standards through a formal consensus process. Further details of the consensus and review processes can be found in Appendix 1.

Medline, EMBASE and the Cochrane Database of Systematic Reviews were searched using terms relating to obesity, pregnancy, services and interventions. Searches were limited to humans and restricted to the titles of English language articles published between January 1998 and January 2008. Meta-analyses, systematic reviews, intervention studies and observational studies were selected if they: 1) related to general care issues for pregnant

obese women, 2) focused on the management of obesity or obesity-related complications in pregnancy, or 3) focused on the relationship between maternal Body Mass Index (BMI) and pregnancy-related outcomes. A list of articles meeting the selection criteria was reviewed by the CMACE Obesity Project's External Advisory Group, a multidisciplinary group of nine senior healthcare professionals with expertise in pregnancy and obesity, and two lay representatives. Additional articles recommended by the External Advisory Group were located and assessed according to the criteria above.

All articles that met the selection criteria were tabulated and organised into categories according to the clinical focus and outcomes of the study.

The National Guidelines Clearing House, the National Electronic Library for Health, OMNI, TRIP and E guidelines were also searched for relevant guidelines.

4. Pre-pregnancy care

4.1. What care should be provided in the primary care setting to women with obesity of childbearing age?

Primary care services should ensure that all women of childbearing age have the opportunity to optimise their weight before pregnancy. Advice on weight and lifestyle should be given during family planning consultations, and weight, body mass index and waist circumference should be regularly monitored.

D

Women of childbearing age with a BMI ≥30 should receive information and advice about the risks of obesity during pregnancy and childbirth, and be supported to lose weight before conception.

D

Compared to women with a healthy pre-pregnancy weight, pregnant women with obesity are at increased risk of miscarriage,[6] gestational diabetes,[10] pre-eclampsia,[11] venous thromboembolism,[8,9] induced labour,[20] caesarean section,[17] anaesthetic complications[21,22] and wound infections,[10] and they are less likely to initiate or maintain breastfeeding.[18] Babies of obese mothers are at increased risk of stillbirth,[13 14] congenital anomalies,[7] prematurity,[23] macrosomia [10,15,20] and neonatal death.[14-16] Intrauterine exposure to maternal obesity is also associated with an increased risk of developing obesity and metabolic disorders in childhood.[24] Please see table in Appendix 3 for further information on risks.

Evidence level 2++

It is important that women are aware of the increased risk of maternal and fetal complications associated with obesity, and they should be advised about the possible strategies to minimise them prior to conception.

A Swedish population-based observational study of 151,025 women examined the association of change in BMI between successive pregnancies with adverse outcomes during the second pregnancy. The risk of pre-eclampsia, gestational diabetes mellitus (GDM), large-for-gestational-age babies, caesarean section and stillbirth was linearly related to interpregnancy weight gain.[25]

Evidence level 2+

Interpregnancy weight reduction among women with obesity has been shown to significantly reduce the risk of developing GDM. A population-based cohort study of 4102 non-diabetic women with maternal obesity prior to their first singleton pregnancy found that a weight loss of at least 4.5 kg before the second pregnancy reduced the risk of developing GDM by up to 40%.[26] Although it has been suggested that some weight loss regimens during the first trimester may increase the risk of fetal neural tube defects (NTD), weight loss prior to pregnancy does not appear to carry this risk.[27]

Evidence level 2-

4.2. What nutritional supplements should be recommended to women with obesity who wish to become pregnant?

Women with a BMI ≥30 wishing to become pregnant should be advised to take 5mg folic acid supplementation daily, starting at least one month before conception and continuing during the first trimester of pregnancy.

B

In the general maternity population, maternal folate deficiency is associated with fetal congenital malformations,[28] and periconceptional use of folic acid supplementation reduces the risk of the first occurrence, as well as the recurrence, of NTDs (relative risk (RR) 0.28, 95% confidence interval (CI) 0.13–0.58).[29]

In women at high risk of fetal NTD (due to previous pregnancy with NTD), a randomised double-blind prevention trial has shown that a higher dose of folic acid supplementation (4mg/day) reduces the risk of a subsequent NTD-affected pregnancy by 72% (RR 0.28, 95% CI 0.12–0.71).[30]

† Evidence level 1++

Women with a raised BMI are at increased risk of NTD, with a meta-analysis of 12 observational cohort studies reporting an odds ratio (OR) of 1.22 (95% CI 0.99–1.49), 1.70 (95% CI 1.34–2.15) and 3.11 (95% CI 1.75–5.46) for women defined as overweight, obese and severely obese, respectively, compared with healthy-weight women.[7]

Evidence level 2++

There is evidence from cross-sectional data that, compared to women with a BMI <27, women with a BMI ≥27 are less likely to use nutritional supplements and less likely to receive folate through their diet. However, compared to women with a BMI <27, women with a BMI ≥27 have lower serum folate levels even after controlling for folate intake.[31]

Evidence level 2+

The findings from the studies above suggest that obese women should receive higher doses of folate supplementation in order to minimise the increased risk of fetal NTDs.

Health professionals should take particular care to check that women with a booking BMI ≥30 are following advice to take 10micrograms Vitamin D supplementation daily during pregnancy and while breastfeeding.[32] ‡

C

Pre-pregnancy BMI is inversely associated with serum vitamin D concentrations among pregnant women, and women with obesity (BMI ≥30) are at increased risk of vitamin D deficiency compared to women with a healthy weight (BMI<25).[33] Cord serum Vitamin D levels in babies of obese women have also been found to be lower than babies born to non-obese women.[33]

* Evidence level 2+

The main source of vitamin D is synthesis on exposure of the skin to sunlight. However, in the UK there is limited sunlight of the appropriate wavelength, particularly during winter. A recent survey in Britain showed that about a quarter of British women aged 19–24 and a sixth of those aged 25–34 are at risk of vitamin D deficiency.[34] Maternal skin exposure alone may not always be enough to achieve the optimal vitamin D status needed for pregnancy and the recommended oral intake of 10micrograms Vitamin D daily for all pregnant and breastfeeding women cannot usually be met from diet alone.

5. Provision of antenatal care

5.1. How should antenatal care be provided for women with obesity?

Management of women with obesity in pregnancy should be integrated into all antenatal clinics, with clear policies and guidelines for care available.

D

† Evidence extrapolated to women with obesity and used to derive grade of standard
‡ Additional standard identified by the RCOG Guideline Committee
* Evidence level used to derive grade of standard

The prevalence of obesity in pregnancy has increased significantly since the early 1990s,[4,5] and this is expected to continue in parallel with increasing prevalence in the general population. Specialist clinics are unlikely to be feasible in areas of high prevalence due to resource issues, and it is important that all health professionals providing maternity care are aware of the maternal and fetal risks and the specific interventions required to minimise these risks.

6. Measuring weight, height and BMI

6.1. How and when should maternal weight, height and BMI be measured in the general maternity population?

All pregnant women should have their weight and height measured using appropriate equipment, and their body mass index calculated at the antenatal booking visit. Measurements should be recorded in the handheld notes and electronic patient information system.

Appropriate management of women with maternal obesity can only be possible with consistent identification of those women who are at risk. The NICE Antenatal Care guideline (2008) recommends that maternal height and weight should be recorded for all women at the initial booking visit (ideally by 10 weeks gestation) to allow the calculation of BMI.[35] Semi-structured interviews of health professionals in the North East Government Office Region of England suggested that self-reported rather than measured height and weight are used at some community booking visits due to lack of availability of appropriate equipment.[36] However, self-reported height is often overestimated and self-reported weight underestimated, particularly in obese women,[37] which may lead to inaccurate risk assessment during pregnancy.

Mandatory height and weight data fields in electronic patient information systems, and functionality allowing the automatic calculation of BMI, may be useful to enable local organisations to achieve 100% compliance with this standard.

For women with obesity in pregnancy, re-measurement of maternal weight during the third trimester will allow appropriate plans to be made for equipment and personnel required during labour and delivery.

7. Information-giving during pregnancy

7.1. What information should be provided to women with maternal obesity?

All pregnant women with a booking BMI ≥30 should be provided with accurate and accessible information about the risks associated with obesity in pregnancy and how they may be minimised. Women should be given the opportunity to discuss this information.

While pre-conception advice and care is the ideal scenario for women with obesity, those women presenting for the first time during pregnancy should be given an early opportunity to discuss potential risks and management options with a healthcare professional. The aim is to provide appropriate information sensitively, which empowers the woman to actively engage with health professionals and the services available to her. Relevant information will include the increased risk of pre-eclampsia, gestational diabetes and fetal macrosomia requiring an increased level of maternal and fetal monitoring; the potential for poor ultrasound visualisation of the baby and consequent difficulties in fetal surveillance and screening for anomalies; the potential for difficulty with intrapartum fetal monitoring, anaesthesia and caesarean section which would require senior obstetric and anaesthetic involvement and an antenatal anaesthetic assessment; and the need to prioritise the safety of the mother at all times. Women should be made aware of the importance of healthy eating and appropriate exercise during pregnancy in order to prevent excessive weight gain and gestational diabetes. Dietetic advice by an appropriately trained professional should be provided early in the pregnancy.

The table in Appendix 3 provides further information on the risks of specific outcomes.

8. Risk assessment during pregnancy

8.1. What specific risk assessments are required for women with maternal obesity?

Pregnant women with a booking BMI ≥40 should have an antenatal consultation with an obstetric anaesthetist, so that potential difficulties with venous access, regional or general anaesthesia can be identified. An anaesthetic management plan for labour and delivery should be discussed and documented in the medical records.

D

Obese pregnant women are at higher risk of anaesthesia-related complications than women with a healthy BMI, and obesity has been identified as a significant risk factor for anaesthesia-related maternal mortality.[19,38] Women with class III obesity will be at highest risk and it is recommended that local anaesthetic resources are focused on this group of women. Maternity services may decide to use a lower BMI threshold, taking into consideration the local prevalence of maternal obesity.

Evidence level 3

Epidural re-site rates have been reported to increase with increasing BMI,[21] and the initial failure rate of epidural cannulation in parturients with morbid obesity has been reported to be as high as 42% in one hospital.[39] For these reasons, an early epidural may be advisable.

It is recognised that obesity may increase the risk of aspiration of gastric contents under general anaesthesia, difficult endotracheal intubation and postoperative atelectasis.[22] These women are also more likely to have co-morbidites such as hypertension and ischaemic heart disease.

Evidence level 2-

Women with a booking BMI ≥40 should have a documented assessment in the third trimester of pregnancy by an appropriately qualified professional to determine manual handling requirements for childbirth and consider tissue viability issues.

D

Manual handling requirements include consideration of safe working loads of beds and theatre tables, the provision of appropriate lateral transfer equipment, hoists, and appropriately sized thromboembolic deterrent stockings (TEDS). There is also an increased risk of pressure sores when a woman may be relatively immobile and regular inspection of potential pressure areas is important.[40] A formal assessment of this risk should be made using validated scoring tools, and appropriate plans put in place with regard to body positions, repositioning schedules, skin care and support surfaces.

For women with obesity in pregnancy, re-measurement of maternal weight during the third trimester will allow appropriate plans to be made for equipment and personnel required during labour and delivery.

Some women with a booking BMI <40 may also benefit from assessment of manual handling requirements in the third trimester and this should be decided on an individual basis by the lead health professional providing maternity care.

9. Thromboprophylaxis

9.1. What precautions should be taken to minimise the risk of thromboembolism in women with maternal obesity?

Women with a booking BMI ≥30 should be assessed at their first antenatal visit and throughout pregnancy for the risk of thromboembolism. Antenatal and post delivery thromboprophylaxis should be considered in accordance with the RCOG Clinical Green Top Guideline No. 37.[41]

B

Maternal obesity is associated with a significant risk of thromboembolism during both the antenatal and postnatal period. A retrospective case-control study in Denmark, including 129 women with deep vein thrombosis (DVT) or pulmonary embolism (PE) during pregnancy or the puerperium and 258 controls (pregnant women with no venous thromboembolism), showed a significant association between venous thromboembolism and BMI ≥30 (adjusted OR (aOR) 5.3, 95% CI 2.1–13.5).[9] More recently, a national matched case-control study conducted by the United Kingdom Obstetric Surveillance System (UKOSS) reported that a BMI ≥30 was associated with an aOR of 2.65 (95% CI 1.09–6.45) for antenatal pulmonary thromboembolism (PTE).[42]

* Evidence level 2++

The RCOG Clinical Green Top Guideline No. 37 advises that:

- A woman with a BMI ≥30 who also has two or more additional risk factors for thromboembolism should be considered for prophylactic low molecular weight heparin (LMWH) antenatally. This should begin as early in pregnancy as practical.
- All women receiving LMWH antenatally should usually continue prophylactic doses of LMWH until six weeks postpartum, but a postnatal risk assessment should be made.

Women with a booking BMI ≥30 requiring pharmacological thromboprophylaxis should be prescribed doses appropriate for maternal weight, in accordance with the RCOG Clinical Green Top Guideline No. 37.[41]

D

The RCOG Clinical Green Top Guideline No. 37 gives the following weight-specific dosage advice:

Weight (kg)	Dose
91-130	60 mg Enoxaparin; 7500 units Dalteparin; 7000 units Tinzaparin daily
131-170	80 mg Enoxaparin; 10000 units Dalteparin; 9000 units Tinzaparin daily
>170	0.6 mg/kg/day Enoxaparin; 75 units/kg/day Dalteparin; 75 units/kg/day Tinzaparin

Women with a BMI ≥30 should be encouraged to mobilise as early as practicable following childbirth to reduce the risk of thromboembolism.

B

Both immobility and obesity are independently associated with thromboembolism; in combination, however, they can pose a much greater risk. This interaction has been demonstrated by a large case-control study that reported an aOR of 62.3 (95% CI 11.5–337.6) for antenatal venous thromboembolism (VTE) and 40.1 (95% CI 8.0–201.5) for postnatal VTE in women with a BMI ≥25 where there was evidence of immobilisation, compared with women with a BMI <25 and no immobilisation.[8] In contrast, women with a BMI ≥25 without evidence of immobilisation had a much lower aOR of 1.8 (95% CI 1.3–2.4) for antenatal VTE and 2.4 (95% CI 1.7–3.3) for postnatal VTE.

* Evidence level 2++

All women with a BMI ≥40 should be offered postnatal thromboprophylaxis regardless of their mode of delivery.

D

This recommendation is in line with the recently updated RCOG Guideline No. 37, which states that for these women thromboprophylaxis should be continued for a minimum of one week.[41] In addition, the guideline recommends the following:

- Women with a BMI ≥30 who have one or more additional persisting risk factors for thromboembolism should also be considered for LMWH for seven days after delivery.
- Women with a BMI ≥30 who have two or more additional persisting risk factors should be given graduated compression stockings in addition to LMWH.

10. Maternal surveillance and screening

10.1. What specific considerations should be given to maternal surveillance for women with obesity?

An appropriate size of arm cuff should be used for blood pressure measurements taken at the booking visit and all subsequent antenatal consultations. The cuff size used should be documented in the medical records.

C

The effects of three different arm cuff sizes (standard (12x23cm), large (15x33cm) and thigh (18x36cm)) on blood pressure measurement were evaluated in 1240 adults. The differences in readings between the three cuffs were smallest in non-obese subjects and became progressively greater with increasing arm circumference in the obese population. Less error was introduced by using too large a cuff than by too small a cuff.[43]

* Evidence level 2+

Women with a booking BMI ≥35 have an increased risk of pre-eclampsia and should have surveillance during pregnancy in accordance with the Pre-eclampsia Community Guideline (PRECOG), 2004.[44]

B

A number of good-quality observational studies have shown clearly that obesity is associated with an increased risk of pre-eclampsia.[10,11,15,23,45-49]

A Swedish cohort study of 805,275 pregnancies to women delivering between 1992 and 2001 found that the incidence of pre-eclampsia ranged from 1.4% among women with a BMI 19.8–26.0 to 3.5% among those with morbid obesity (BMI >40) (aOR 4.82, 95% CI 4.04–5.74).[15] Similar increases in risk have been reported for pregnancy induced hypertension and pre-eclampsia in an Australian cohort study, in which the incidence ranged from 2.4% in women with a BMI 19.8-26.0 to 14.5% (aOR 4.87, 95% CI 3.27–7.24) in women with a BMI >40.[23]

A systematic review of risk factors for pre-eclampsia found that, compared to a healthy BMI, a raised booking BMI, as defined within each study, was associated with a 50% increase in the risk of pre-eclampsia, while a booking BMI >35 doubled the pre-eclampsia risk.[47]

* Evidence level 2++

The PRECOG Guideline states that:

- Women with a booking BMI ≥35 who also have at least one additional risk factor for pre-eclampsia should have referral early in pregnancy for specialist input to care. Additional risk factors include: first pregnancy, previous pre-eclampsia, ≥10 years since last baby, ≥40 years, family history of pre-eclampsia, booking diastolic BP ≥80mmHg, booking proteinuria ≥1+ on more than one occasion or ≥0.3g/24 hours, multiple pregnancy, and certain underlying medical conditions such as antiphospholipid antibodies or pre-existing hypertension, renal disease or diabetes.
- Women with a booking BMI ≥35 with no additional risk factor can have community monitoring for pre-eclampsia at a minimum of 3 weekly intervals between 24 and 32 weeks gestation, and 2 weekly intervals from 32 weeks to delivery.

The NICE Clinical Guideline on Hypertensive disorders during pregnancy (in draft, due to be published April 2010) states that although moderate risk factors for pre-eclampsia (including obesity, first pregnancy, maternal

age >40 years, family history of pre-eclampsia, multiple pregnancy) are poorly defined in the published literature, it is the considered opinion of the NICE Guideline Development Group that women with more than one moderate risk factor may benefit from taking 75mg aspirin daily from 12 weeks' gestation until birth of the baby.[50]

All pregnant women with a booking BMI ≥30 should be screened for gestational diabetes, as recommended by the NICE Clinical Guideline No. 63 (Diabetes in Pregnancy, July 2008).[51]

B

Maternal obesity is known to be an important risk factor for GDM with a number of large cohort studies reporting a three-fold increased risk compared to women with a healthy weight.[10,23,45,46,49]

Evidence level 2++

A randomised controlled trial of 1000 women with GDM found that treatment, comprising dietary advice, blood glucose monitoring and insulin therapy as needed, significantly reduced the risk of a composite measure of serious adverse perinatal outcome (death, shoulder dystocia, bone fracture, and/or nerve palsy) compared to routine care, where women and their care providers were unaware that GDM was present (adjusted RR 0.33, 95% CI 0.14–0.75).[52]

† Evidence level 1+

The NICE Clinical Guideline No. 63 recommends that women with a BMI>30 should have a 2 hour 75g oral glucose tolerance test at 24-28 weeks,[51] using the criteria defined by the World Health Organisation.

11. Planning labour and delivery

11.1. What should be discussed with women with maternal obesity regarding labour and delivery?

Women with a booking BMI ≥30 should have an informed discussion antenatally about possible intrapartum complications associated with a high BMI, and management strategies considered. This should be documented in the notes.

D

Observational studies have shown that there is a higher incidence of intrapartum complications among women with obesity compared to women with a healthy weight. There is an increased risk of slow labour progression,[12,46] shoulder dystocia[15,20] and emergency caesarean section.[10,20] There is also an increased risk of primary postpartum haemorrhage.[10,20]

A meta-analysis of 33 cohort studies showed that the OR for caesarean section (either elective or emergency) was 1.46 (95% CI 1.34–1.60) and 2.05 (95% CI 1.86– 2.27) respectively among women defined as overweight and obese in individual studies, compared to women with a normal weight.[17] Caesarean section can be more technically difficult in these women and there is a higher risk of anaesthetic complications compared to healthy-weight women.[21,22] The decision for mode of delivery should therefore be taken only after careful consideration of the individual circumstances and in conjunction with the full multidisciplinary team and the woman herself.

Evidence level 2++

Women should be given the opportunity to discuss how the complications outlined above can be minimised. They should also be aware of the possible technical difficulties with intravenous access, regional anaesthesia and fetal surveillance in labour, and how these are likely to be addressed (see section 12).

Women with a booking BMI ≥30 should be referred to a consultant obstetrician to enable this discussion. The timing of the referral should be agreed by local maternity services, taking into account the local prevalence of maternal obesity and the antenatal care structures in place.

Women with a booking BMI ≥30 should have an individualised decision for VBAC (vaginal birth after caesarean) following informed discussion and consideration of all relevant clinical factors.

D

Deciding the planned mode of delivery following previous caesarean section requires consideration of the circumstances surrounding the previous caesarean and the current clinical situation, with full involvement of the woman. Women with obesity have additional risks needing consideration. Obesity is a risk factor for unsuccessful VBAC,[53-55] and morbid obesity carries a greater risk for uterine rupture during trial of labour and neonatal injury.[53] Emergency caesarean section in women with obesity is associated with an increased risk of serious maternal morbidity because anaesthetic and operative difficulties are more prevalent in these women compared to women with a healthy BMI,[22] and this should also be taken into account when discussing the risks and benefits of VBAC.

12. Care during childbirth

12.1. Where should women with obesity give birth?

Women with a BMI ≥35 should give birth in a consultant-led obstetric unit with appropriate neonatal services, as recommended by the NICE Clinical Guideline No. 55 (Intrapartum Care, Sept 2007).[56]

B

Women with obesity are at significantly higher risk of shoulder dystocia[15,20] and postpartum haemorrhage[10,20] and immediate obstetric intervention is vital in these situations. In addition, babies born to mothers with obesity are up to 1.5 times more likely to be admitted to a neonatal intensive care unit than babies born to mothers with a healthy weight.[10,20,46] The odds of admission have been shown to increase with each increasing BMI category, similar to those defined by WHO.[23] Please see the table in Appendix 3 for the specific risks associated with maternal obesity.

* Evidence level 2++

The NICE Clinical Guideline No. 55 recommends that women with BMI ≥35 should be advised to give birth in an obstetric unit to reduce the increased risk of maternal and fetal adverse outcomes. It recommends an individual risk assessment regarding planned place of birth for women with a booking BMI of 30 – 34.

12.2. Is maternal obesity an indication for induction of labour?

In the absence of other obstetric or medical indications, obesity alone is not an indication for induction of labour and a normal birth should be encouraged.

D

Induction of labour carries the risk of failed induction and emergency caesarean section, which can be a high risk procedure in women with obesity. Induction of labour should therefore be reserved for situations where there is a specific obstetric or medical indication, with recourse to senior obstetric and anaesthetic help in the event that abdominal delivery becomes necessary.

12.3. What lines of communication are required during labour and delivery in women with maternal obesity?

The duty anaesthetist covering labour ward should be informed when a woman with a BMI ≥40 is admitted to the labour ward if delivery or operative intervention is anticipated. This communication should be documented by the attending midwife in the notes.

D

An opportunity for early assessment will allow the duty anaesthetist to review documentation of the antenatal anaesthetic consultation, identify potential difficulties with regional and/or general anaesthesia, and alert senior colleagues if necessary. An early epidural may be advisable depending on the clinical scenario.

Women with a BMI ≥40 have the highest risk of anaesthetic complications and it is recommended that local anaesthetic resources are focused on this group of women. Maternity services may decide to use a lower BMI threshold, taking in consideration the local prevalence of maternal obesity.

Operating theatre staff should be alerted regarding any woman whose weight exceeds 120kg and who is due to have an operative intervention in theatre. D

An operating table with the appropriate safe working load and appropriate lateral transfer equipment should be available prior to the woman's transfer to theatre.

An obstetrician and an anaesthetist at Specialty Trainee year 6 and above, or with equivalent experience in a non-training post, should be informed and available for the care of women with a BMI ≥40 during labour and delivery, including attending any operative vaginal or abdominal delivery and physical review during the routine medical ward round. D

RCOG Good Practice No. 8 (March 2009)[57] recommends that if the trainee obstetrician on duty for the labour ward has not been assessed and signed-off as competent to carry out caesarean section on women with a BMI>40, the consultant on-call for labour ward should attend in person or be immediately available. Operative vaginal and abdominal deliveries are often technically difficult in women with morbid obesity, and appropriately experienced clinicians should be present to perform or supervise delivery. Regular senior medical review also supports timely identification of any potential intrapartum complications.

12.4. What midwifery support should be available during labour to women with a high BMI?

Women with a BMI ≥40 who are in established labour should receive continuous midwifery care. D

Continuous midwifery care is recommended for all women in established labour. Women with morbid obesity need extra vigilance with regard to care of pressure areas and ensuring normal labour progress. Fetal heart rate monitoring can be a challenge, and close surveillance is required with recourse to fetal scalp electrode or ultrasound assessment of the fetal heart if necessary.

12.5. What specific interventions are required during labour and delivery for women with maternal obesity?

Women with a BMI ≥40 should have venous access established early in labour. D

Establishing venous access in women with morbid obesity is more likely to be difficult than in women with lesser degrees of obesity, and it is important that this is not attempted for the first time in an emergency situation when urgent venous access is required for intravenous medication or for resuscitation.

All women with a BMI ≥30 should be recommended to have active management of the third stage of labour. This should be documented in the notes. B

Obesity is associated with an increased risk of postpartum haemorrhage.[10] | Evidence level 2++

There is strong evidence from the general maternity population that active management of the third stage of labour reduces the risk of postpartum haemorrhage, post partum anaemia and the need for blood transfusion.[58] Active management in all women is associated with a reduced incidence of prolonged third stage of labour and with a reduction in the use of therapeutic oxytocic drugs.

† Evidence level 1++

Women with a BMI ≥30 having a caesarean section have an increased risk of wound infection, and should receive prophylactic antibiotics at the time of surgery, as recommended by the NICE Clinical Guideline No. 13 (Caesarean Section, April 2004).[59]

A retrospective observational study of 287,213 singleton pregnancies reported an aOR of 2.24 (99% CI 1.91–2.64) for wound infection in obese women compared with healthy-weight women.[10]

Evidence level 2++

In the general maternity population, a systematic review of randomised trials in women undergoing elective or non-elective caesarean sections showed that the incidence of wound infections was significantly reduced with antibiotic prophylaxis compared with no prophylaxis.[60] The RR of infection for elective caesarean section was 0.73 (95% CI 0.53–0.99), for non-elective caesarean section 0.36 (95% CI 0.26–0.51), and for all caesareans 0.41 (95% CI 0.29–0.43).

† Evidence level 1++

The NICE clinical guideline No 13 recommendation applies to all women regardless of BMI and recommends that women undergoing caesarean section should be offered a single prophylactic dose of first generation cephalosporin or ampicillin in order to reduce the risk of postoperative infections (endometritis, urinary tract or wound infections).

As recommended by the NICE Clinical Guideline No. 13 (Caesarean Section, April 2004), women undergoing caesarean section who have more than 2cm subcutaneous fat, should have suturing of the subcutaneous tissue space in order to reduce the risk of wound infection and wound separation.[59] ‡

Two RCTs randomised 76 and 91 women, respectively, who had at least 2cm subcutaneous fat to closure or non-closure of the subcutaneous tissue space.[61,62] Meta analysis of these RCTs showed that closure of the subcutaneous space decreased the incidence of wound complications (RR 0.42, 95% CI 0.22 to 0.81).[59]

* Evidence level 1++

13. Postnatal care and follow-up after pregnancy

13.1. How can the initiation and maintenance of breastfeeding in women with maternal obesity be optimised?

Obesity is associated with low breastfeeding initiation and maintenance rates. Women with a booking BMI ≥30 should receive appropriate specialist advice and support antenatally and postnatally regarding the benefits, initiation and maintenance of breastfeeding.

‡ Additional standard identified by the RCOG Guideline Committee

Maternal obesity is associated with reduced breastfeeding rates, both in terms of breastfeeding initiation and duration.[18,63] This is likely to be multifactorial in origin; women's perception of breastfeeding; difficulty with correct positioning of the baby; and the possibility of an impaired prolactin response to suckling.[64]

Evidence level 2++

Evidence derived from randomised controlled trials in the general maternity population shows that breastfeeding education and support is associated with higher breastfeeding initiation rates and, in some instances, longer durations of breastfeeding.[65,66]

† Evidence level 1+

Women with obesity should have an opportunity during the antenatal period to discuss the benefits of breastfeeding and the support that will be available to them, so that they can make an informed decision regarding feeding choices. Dedicated breastfeeding support during the postnatal period is also needed to overcome any potential difficulties with feeding.

13.2. What ongoing care should be provided to women with maternal obesity following pregnancy?

Women with a booking BMI ≥30 should continue to receive nutritional advice following childbirth from an appropriately trained professional, with a view to weight reduction.

C

A small number of randomised controlled trials have assessed the effect of postnatal lifestyle interventions on weight reduction. Modification of dietary and physical activity behaviour are associated with a significant reduction in body weight compared to no lifestyle intervention.[67-69] Maternity services need to identify what services are available locally to provide this follow up.

† Evidence level 1-

All women with a booking BMI ≥30 who have been diagnosed with gestational diabetes should have a test of glucose tolerance approximately 6 weeks after giving birth.

D

Women with a booking BMI ≥30 and gestational diabetes who have a normal test of glucose tolerance following childbirth, should have regular follow up with the GP to screen for the development of type 2 diabetes.

B

A systematic review and meta-analysis found that women with GDM had an increased risk of developing type 2 diabetes compared with those who had a normoglycaemic pregnancy (RR 7.43, 95% CI 4.79–11.51).[70]

In an earlier systematic review, there was a steep increase in incidence of type 2 diabetes within the first 5 years following a pregnancy with GDM; however after 5 years the conversion of GDM to type 2 diabetes appeared to plateau.[71]

* Evidence level 2++

Data from an observational cohort study of 330 Danish women with diet-treated GDM showed that 41% of these women developed diabetes during a median of 10 years follow-up.[72] This reflected a doubling of the risk compared to an earlier cohort of 241 women with GDM followed by the same research group ten years previously. Pre-pregnancy overweight and obesity were found to be significant risk factors for the development of type 2 diabetes in these women (aOR 2.0 (95% CI 1.1–3.4) and 2.6 (95% CI 1.5–4.5), respectively).

Evidence level 2+

All women with a booking BMI ≥30 who have been diagnosed with gestational diabetes should have annual screening for cardio-metabolic risk factors, and be offered lifestyle and weight management advice.

B

There is good evidence from a number of large randomised controlled trials that lifestyle interventions can prevent or delay the development of diabetes in high-risk individuals. Compared to standard care, exercise plus diet interventions in high-risk populations, primarily those with impaired glucose tolerance, are associated with a RR of 0.63 (95% CI 0.49–0.79) for developing diabetes.[73]

† Evidence level 1++

14. Local guidelines

14.1. What should be included in local guidelines on the management of maternal obesity?

All maternity units should have accessible multidisciplinary guidelines which are communicated to all individuals and organisations providing care to pregnant women with a booking BMI ≥30. These guidelines should include consideration of:

D

- **Referral criteria**
- **Facilities and equipment**
- **Care in pregnancy**
- **Place of birth and care in labour**
- **Provision of anaesthetic services**
- **Management of obstetric emergencies**
- **Postnatal advice**

Obesity in pregnancy is recognised by the NHS Litigation Authority (NHSLA)'s Clinical Negligence Scheme for Trusts as one of the high risk conditions requiring the availability of a local guideline at all maternity units.[74]

15. Facilities and equipment

15.1. What are the processes to ensure that maternity units have appropriate facilities and equipment for women with obesity?

All maternity units should have a documented environmental risk assessment regarding the availability of facilities to care for pregnant women with a booking BMI ≥30. This risk assessment should address the following issues:

D

- **Circulation space**
- **Accessibility including doorway widths and thresholds**
- **Safe working loads of equipment (up to 250kg) and floors**
- **Appropriate theatre gowns**
- **Equipment storage**
- **Transportation**
- **Staffing levels**
- **Availability of, and procurement process for, specific equipment:**
  - large blood pressure cuffs
  - sit-on weighing scale
  - large chairs without arms
  - large wheelchairs
  - ultrasound scan couches
  - ward and delivery beds

- theatre trolleys
- operating theatre tables
- lifting and lateral transfer equipment

A minimum requirement for maternity services within the NHSLA's Clinical Negligence Scheme for Trusts (CNST) is the availability of suitable equipment for women with a high BMI, and it is recommended that units should have a documented process to assess this on a regular basis.[74] It is also recognised good practice for maternity units to have an ultrasound machine and extra-long spinal and epidural needles available at all times on the labour ward.

Maternity units should have a central list of all facilities and equipment required to provide safe care to pregnant women with a booking BMI ≥30. The list should include details of safe working loads, product dimensions, where specific equipment is located and how to access it.

D

16. Education of health professionals

16.1. What are the education and training needs for health professionals specific to maternal obesity?

All health professionals involved in the care of pregnant women should receive education about maternal nutrition and its impact on maternal, fetal and child health.

D

Dietary and lifestyle choices contribute to obesity in both general and maternity populations. A study of 2394 pregnant women with complete dietary, weight and height data found that women classified as obese were significantly more likely to be in the lowest versus the highest diet quality tertile compared with underweight women (OR 1.87, 95% CI 1.37–2.55).[75]

Evidence level 2+

All health professionals involved in maternity care should receive training in manual handling techniques and the use of specialist equipment which may be required for pregnant and postnatal women with obesity.

D

17. Areas for further research

Research is needed to determine the optimal weight gain during pregnancy for women in different BMI categories.

Evidence-based guidance is required on the optimal caesarean section technique for women with obesity in pregnancy.

18. Auditable standards

- Proportion of women with booking BMI ≥30 who commenced 5mg folic acid supplementation daily prior to conception
- Proportion of women with booking BMI ≥30 who commenced 10 micrograms of vitamin D daily before or during pregnancy
- Proportion of pregnant women who have a record of maternal height, weight and BMI in the maternity hand held notes and on the electronic patient information system
- Proportion of maternity health care professionals who have had training in manual handling techniques and the use of specialist bariatric equipment within the previous year
- Proportion of women with a booking BMI ≥40 who had an antenatal anaesthetic review
- Proportion of women with a booking BMI ≥30 plus two other risk factors for VTE, as outlined in RCOG Green- top Guideline No. 37 (2004), who had pharmacological thromboprophylaxis prescribed antenatally
- Proportion of women with a booking BMI ≥40 who had pharmacological thromboprophylaxis prescribed postnatally
- Proportion of women with a booking BMI ≥30 who had a glucose tolerance test during pregnancy
- Proportion of women with a booking BMI ≥30 who had active management of the third stage of labour
- Indications for induction of labour in women with booking BMI ≥30
- Proportion of operative vaginal deliveries and caesarean sections in women with a booking BMI ≥40, which were attended by an obstetrician and anaesthetist at Specialty Trainee level 6 or above

References

1. National Institute for Health and Clinical Excellence. Obesity. Guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children. London: National Institute for Health and Clinical Excellence (NICE), 2006.
2. World Health Organization. Obesity: Preventing and managing the global epidemic. Geneva: World Health Organization, 2000.
3. Office for National Statistics. Statistics on Obesity, Physical Activity and Diet: England, January 2008. London, 2008.
4. Heslehurst N, Ells LJ, Simpson H, Batterham A, Wilkinson J, Summerbell CD. Trends in maternal obesity incidence rates, demographic predictors, and health inequalities in 36,821 women over a 15-year period. *BJOG: An International Journal of Obstetrics and Gynaecology* 2007;114(2):187-94.
5. Kanagalingam MG, Forouhi NG, Greer IA, Sattar N. Changes in booking body mass index over a decade: retrospective analysis from a Glasgow Maternity Hospital. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(10):1431-3.
6. Lashen H, Fear K, Sturdee DW. Obesity is associated with increased risk of first trimester and recurrent miscarriage: matched case-control study. *Human Reproduction* 2004;19(7):1644-6.
7. Rasmussen SA, Chu SY, Kim SY, Schmid CH, Lau J. Maternal obesity and risk of neural tube defects: a metaanalysis. *American Journal of Obstetrics and Gynecology* 2008;198(6):611-619.
8. Jacobsen AF, Skjeldestad FE, Sandset PM. Ante- and postnatal risk factors of venous thrombosis: a hospital-based case control study. *Journal of Thrombosis and Haemostasis* 2008;6(6):905-912.
9. Larsen TB, Sorensen HT, Gislum M, Johnsen SP. Maternal smoking, obesity, and risk of venous thromboembolism during pregnancy and the puerperium: a population-based nested case-control study. *Thrombosis Research* 2007;120(4):505-9.
10. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 2001;25(8):1175-82.
11. O'Brien TE, Ray JG, Chan W-S. Maternal body mass index and the risk of preeclampsia: a systematic overview. *Epidemiology* 2003;14(3):368-74.
12. Nuthalapaty FS, Rouse DJ, Owen J. The association of maternal weight with cesarean risk, labor duration, and cervical dilation rate during labor induction.[erratum appears in Obstet Gynecol. 2004 May;103(5 Pt 1):1019]. *Obstetrics and Gynecology* 2004;103(3):452-6.
13. Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, et al. Maternal obesity and risk of stillbirth: a metaanalysis. *American Journal of Obstetrics & Gynecology* 2007;197(3):223-8.
14. Kristensen J, Vestergaard M, Wisborg K, Kesmodel U, Secher NJ. Pre-pregnancy weight and the risk of stillbirth and neonatal death. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(4):403-408.
15. Cedergren MI. Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstetrics and Gynecology* 2004;103(2):219-24.
16. Shah A, Sands J, Kenny L. Maternal obesity and the risk of still birth and neonatal death. *Journal of Obstetrics and Gynaecology* 2006;26(Supplement 1):S19.
17. Chu SY, Kim SY, Schmid CH, Dietz PM, Callaghan WM, Lau J, et al. Maternal obesity and risk of cesarean delivery: a meta-analysis. *Obesity Reviews* 2007;8(5):385-94.
18. Amir LH, Donath S. A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *MC Pregnancy and Childbirth* 2007;7:9.
19. Lewis G, editor. *Confidential Enquiry into Maternal and Child Health. Saving Mothers' Lives - Reviewing maternal deaths to make motherhood safer 2003-2005.* London: CEMACH, 2007.

20. Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(6):768-772.

21. Dresner M, Brocklesby J, Bamber J. Audit of the influence of body mass index on the performance of epidural analgesia in labour and the subsequent mode of delivery. *BJOG: An International Journal of Obstetrics and Gynaecology* 2006;113(10):1178-81.

22. Saravanakumar K, Rao SG, Cooper GM. The challenges of obesity and obstetric anaesthesia. *Current Opinion in Obstetrics & Gynecology* 2006;18(6):631-5.

23. Callaway LK, Prins JB, Chang AM, McIntyre HD. The prevalence and impact of overweight and obesity in an Australian obstetric population. *Medical Journal of Australia* 2006;184(2):56-9.

24. Boney CM, Verma A, Tucker R, Vohr BR. Metabolic Syndrome in Childhood: Association With Birth Weight, Maternal Obesity, and Gestational Diabetes Mellitus. *Pediatrics* 2005;115(3):e290-296.

25. Villamor E, Cnattingius S. Interpregnancy weight change and risk of adverse pregnancy outcomes: a population-based study. *The Lancet* 2006;368(9542):1164-1170.

26. Glazer NL, Hendrickson AF, Schellenbaum GD, Mueller BA. Weight change and the risk of gestational diabetes in obese women. *Epidemiology* 2004;15(6):733-737.

27. Carmichael SL, Shaw GM, Schaffer DM, Laurent C, Selvin S. Dieting behaviors and risk of neural tube defects. *American Journal of Epidemiology* 2003;158(12):1127-1131.

28. Scholl TO, Johnson WG. Folic acid: influence on the outcome of pregnancy. *American Journal of Clinical Nutrition* 2000;71(5):1295S-1303.

29. Lumley J, Watson L, Watson M, Bower C. Periconceptional supplementation with folate and/or multivitamins for preventing neural tube defects. *Cochrane Database of Systematic Reviews* 2001(3).

30. MRC Vitamin Study Research Group. Prevention of neural tube defects: results of the Medical Research Council Vitamin Study. MRC Vitamin Study Research Group. *The Lancet* 1991;338(8760):131-7.

31. Mojtabai R. Body mass index and serum folate in childbearing age women. *European Journal of Epidemiology* 2004;19(11):1029.

32. National Institute for Health and Clinical Excellence. NICE public health guidance 11: Improving the nutrition of pregnant and breastfeeding mothers and children in low-income households. London: National Institute for Health and Clinical Excellence, 2008.

33. Bodnar LM, Catov JM, Roberts JM, Simhan HN. Prepregnancy Obesity Predicts Poor Vitamin D Status in Mothers and Their Neonates. *The Journal of Nutrition* 2007;137(11):2437-2442.

34. Office for National Statistics. The national diet and nutrition survey: adults aged 19 to 64 years: nutritional status (anthropometry and blood analytes), blood pressure and physical activity London: The Stationery Office, 2004.

35. National Institute for Health and Clinical Excellence. Antenatal care: Routine care for the healthy pregnant woman. London: RCOG, 2008.

36. Heslehurst N, Lang R, Rankin J, Wilkinson JR, Summerbell CD. Obesity in pregnancy: a study of the impact of maternal obesity on NHS maternity services. *BJOG: An International Journal of Obstetrics and Gynaecology* 2007;114(3):334-42.

37. Gorber SC, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obesity Reviews* 2007;8(4):307-326.

38. Hawkins JL, Koonin LM, Palmer SK, Gibbs CP. Anesthesia-related deaths during obstetric delivery in the United States, 1979-1990. *Anesthesiology* 1997;86(2):277-84.

39. Hood DD, Dewan DM. Anesthetic and obstetric outcome in morbidly obese parturients. *Anesthesiology* 1993;79(6):1210-8.

40. Davidson J, Callery C. Care of the Obesity Surgery Patient Requiring Immediate-Level Care or Intensive Care. *Obesity Surgery* 2001;11(1):93-97.

41. Royal College of Obstetricians and Gynaecologists. Green-Top Guideline No. 37. Reducing the risk of thrombosis and embolism during pregnancy and puerperium. London: Royal College of Obstetricians and Gynaecologists, 2009.

42. Knight, M. on behalf of UKOSS. Antenatal pulmonary embolism: risk factors, management and outcomes. *BJOG: An International Journal of Obstetrics and Gynaecology* 2008;115(4):453-461.

43. Maxwell M, Schroth P, Waks A, Karam M, Dornfeld L. Error in blood-pressure measurement due to incorrect cuff size in obese patients. *The Lancet* 1982;320(8288):33-36.

44. The Pre-eclampsia Community Guideline Development Group. Pre-eclampsia Community Guideline (PRECOG). Middlesex: Action on Pre-Eclampsia (APEC), 2004.

45. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies. *BMC Public Health* 2007;7:168.

46. Bianco AT, Smilen SW, Davis Y, Lopez S, Lapinski R, Lockwood CJ. Pregnancy outcome and weight gain recommendations for the morbidly obese woman. *Obstetrics and Gynecology* 1998;91(1):60-64.

47. Duckitt K, Harrington D. Risk factors for pre-eclampsia at antenatal booking: systematic review of controlled studies. *British Medical Journal* 2005;330(7491):549-550.

48. Sattar N, Clark P, Holmes ANN, Lean MEJ, Walker I, Greer IA. Antenatal Waist Circumference and Hypertension Risk. *Obstetrics and Gynecology* 2001;97(2):268-271.

49. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate--a population-based screening study. *American Journal of Obstetrics & Gynecology* 2004;190(4):1091-7.

50. National Institute for Health and Clinical Excellence. Hypertensive disorders during pregnancy (Draft, accessed January 2010). London: National Institute for Health and Clinical Excellence 2010.

51. National Institute for Health and Clinical Excellence. Diabetes in pregnancy: Management of diabetes and its complications from pre-conception to the postnatal period. London: National Institute for Health and Clinical Excellence, 2008.

52. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS, et al. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. *New England Journal of Medicine* 2005;352(24):2477-86.

53. Hibbard JU, Gilbert S, Landon MB, Hauth JC, Leveno KJ, Spong CY, et al. Trial of labor or repeat cesarean delivery in women with morbid obesity and previous cesarean delivery. *Obstetrics and Gynecology* 2006;108(1):125-33.

54. Goodall PT, Ahn JT, Chapa JB, Hibbard JU. Obesity as a risk factor for failed trial of labor in patients with previous cesarean delivery. *American Journal of Obstetrics & Gynecology* 2005;192(5):1423-6.

55. Juhasz G, Gyamfi C, Gyamfi P, Tocce K, Stone JL. Effect of body mass index and excessive weight gain on success of vaginal birth after cesarean delivery. *Obstetrics and Gynecology* 2005;106(4):741-6.

56. National Institute for Health and Clinical Excellence. Intrapartum Care: Care of healthy women and their babies during childbirth. London: National Institute for Health and Clinical Excellence, 2007.

57. Royal College of Obstetricians and Gynaecologists. Good Practice No. 8. Responsibility of consultant on-call. London: Royal College of Obstetricians and Gynaecologists, 2009.

58. Prendiville WJ, Elbourne D, McDonald S. Active versus expectant management in the third stage of labour.[update of Cochrane Database Syst Rev. 2000;(2):CD000007]. *Cochrane Database of Systematic Reviews* 2000(3).

59. National Institute for Health and Clinical Excellence. Caesarean section. London: Royal College of Obstetricians and Gynaecologists, 2004.

60. Hofmeyr GJ, Smaill FM. Antibiotic prophylaxis for cesarean section. *Cochrane Database of Systematic Reviews* 2002;Issue 3:Art. No.: CD000933. DOI: 10.1002/14651858.CD000933.

61. Allaire AD, Fisch J, McMahon MJ. Subcutaneous drain vs. suture in obese women undergoing cesarean delivery. A prospective, randomized trial. *Journal of Reproductive Medicine* 2000;45(4):327-31.

62. Cetin A, Cetin M. Superficial wound disruption after cesarean delivery: effect of the depth and closure of subcutaneous tissue. *International Journal of Gynaecology and Obstetrics* 1997;57(1):17-21.

63. Mok E, Multon C, Piguel L, Barroso E, Goua V, Christin P, et al. Decreased Full Breastfeeding, Altered Practices, Perceptions, and Infant Weight Change of Prepregnant Obese Women: A Need for Extra Support. *Pediatrics* 2008;121(5):e1319-1324.

64. Rasmussen KM, Kjolhede CL. Prepregnant overweight and obesity diminish the prolactin response to suckling in the first week postpartum. *Pediatrics* 2004;113(5):e465-71.

65. Dyson L, McCormick F, Renfrew MJ. Interventions for promoting the initiation of breastfeeding. *Cochrane Database of Systematic Reviews* 2005(2):CD001688.

66. Fairbank L, O'Meara S, Renfrew MJ, Woolridge M, Sowden AJ, Lister-Sharp D. A systematic review to evaluate the effectiveness of interventions to promote the initiation of breastfeeding. *Health Technology Assessment,* 2000;4(25).

67. Leermakers EA, Anglin K, Wing RR. Reducing postpartum weight retention through a correspondence intervention. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 1998;22(11):1103-9.

68. O'Toole ML, Sawicki MA, Artal R. Structured diet and physical activity prevent postpartum weight retention. *Journal of Women's Health* 2003;12(10):991-8.

69. Lovelady CA, Garner KE, Moreno KL, Williams JP. The effect of weight loss in overweight, lactating women on the growth of their infants. *New England Journal of Medicine* 2000;342(7):449-53.

70. Bellamy L, Casas J-P, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. *The Lancet* 2009;373(9677):1773-1779.

71. Kim C, Newton KM, Knopp RH. Gestational Diabetes and the Incidence of Type 2 Diabetes: A systematic review. *Diabetes Care* 2002;25(10):1862-1868.

72. Lauenborg J, Hansen T, Jensen DM, Vestergaard H, Molsted-Pedersen L, Hornnes P, et al. Increasing Incidence of Diabetes After Gestational Diabetes: A long-term follow-up in a Danish population. *Diabetes Care* 2004;27(5):1194-1199.

73. Orozco LJ, Buchleitner AM, Gimenez-Perez G, Roque I Figuls M, Richter B, Mauricio D. Exercise or exercise and diet for preventing type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews* 2008(3):CD003054.

74. Authority NL. Clinical Negligence Scheme for Trusts: Maternity Clinical Risk Management Standards: NHS Litigation Authority, 2009.

75. Laraia BA, Bodnar LM, Siega-Riz AM. Pregravid body mass index is negatively associated with diet quality during pregnancy. *Public Health Nutrition* 2007;10(9):920-6.

76. Murphy MK, Black NA, Lamping DL, McKee CM, Sanderson CFB, Askham J, et al. Consensus development methods, and their use in clinical guideline development *Health Technology Assessment,* 1998;2(3).

77. Royal College of Obstetricians and Gynaecologists. Development of RCOG Green-top Guidelines: Producing a Clinical Practice Guideline. London: Royal College of Obstetricians and Gynaecologists, 2006.

APPENDIX 1: Process for developing the consensus standards

1. Stakeholder consultation

Forty four stakeholder organisations representing healthcare professionals, researchers or patients with an interest in the area of obesity in pregnancy were identified and invited to suggest aspects of care or service provision that should be addressed by the standards. Twelve organisations responded during the 4-week consultation period in February 2008. Thirty broad areas of care were identified and subsequently presented to the Consensus Standards Group (see below) for consideration.

2. Multidisciplinary consensus standards group

A multidisciplinary group (Consensus Standards Group, CSG) was convened. This comprised 23 members representing disciplines relevant to obesity and pregnancy (see table 1), and two lay representatives with personal experience of obesity and pregnancy. The group included representation from the relevant Royal Colleges: the Royal College of Anaesthetists (RCoA), the Royal College of General Practitioners (RCGP), the Royal College of Midwives (RCM), the Royal College of Obstetricians and Gynaecologists (RCOG), the Royal College of Physicians (RCP) and the Royal College of Paediatrics and Child Health (RCPCH).

Table 1. Disciplines represented by the Consensus Standards Group

Anaesthesia
Dietetics
Endocrinology
General practice
General medicine
Manual handling
Midwifery
Neonatology
Obstetrics
Physiotherapy
Public health
Ultrasonography

3. Consensus process

Evidence tables and the proposed process for standards development were sent to all CSG members in advance of the first meeting. During the meeting the group agreed: 1) the broad areas for the standards, 2) the iteration process for achieving consensus, and 3) the scoring system to include or exclude standards. The process for developing the standards, using a modified Delphi approach,[76] is illustrated in Figure 1.

3.1. First iteration

After the first meeting, an open-ended questionnaire containing the broad areas for standards was sent to the CSG. Members submitted draft standards within their area of expertise, together with the rationale for the standard and references for the supporting evidence. A total of 498 standards were suggested by the group.

Draft standards were sorted and categorised according to common themes by a researcher and senior clinician based at CMACE. Duplicate standards were removed and the remaining 198 standards then edited by CMACE. The CSG provided feedback on any essential re-wording prior to the second iteration.

3.2. Second iteration

The CSG was sent the 198 standards with anonymised supporting rationales and references. Group members were requested to: 1) score each standard on importance (based on potential clinical impact and level of available evidence) and feasibility (based on likelihood of successful implementation), 2) provide a rationale for their scores, 3) consider auditability of the standard, and 4) consider the most appropriate BMI cut-off for specific standards. Importance and feasibility scoring was on a 5-point scale (see table 2 below). Members had the option of not scoring if they felt they lacked sufficient knowledge in the specific area addressed by the standard.

Table 2. The 5-point scale used for scoring standards on importance and feasibility

Importance scale	Feasibility scale
1: Not at all important	1: Not at all feasible
2: Slightly important	2: Slightly feasible
3. Moderately important	3. Moderately feasible
4: Very important	4: Very feasible
5: Extremely important	5: Extremely feasible
X: Unable to score due to insufficient knowledge	X: Unable to score due to insufficient knowledge

Responses to the second iteration were analysed quantitatively to determine whether consensus had been reached. Consensus was defined as 80% of responses occurring within two adjacent scores (e.g. 80% scoring 4 or 5). If ≥80% of members scored a standard highly (4 or 5) for importance, and there were no outliers (scores of 1 or 2), the standard was automatically included. If ≥80% scored a standard poorly (1 or 2) for importance, and there were no outliers (scores of 4 or 5), the standard was automatically excluded. A minimum of five scores were required for each standard; standards without a minimum of five scores remained in the process, regardless of the distribution of scores.

3.3. Third iteration

The CSG was provided with bar charts showing the distribution of importance and feasibility scores from the second iteration, and anonymised comments made to support each importance score. Individual scores were fed back to those who had submitted them so that members were able to review their own scores in comparison to all responses.

For those standards that did not meet the inclusion or exclusion criteria after the first scoring round, members were requested to: 1) re-score each standard for importance and feasibility, 2) provide any comments that had not been made previously in order to support their scores, and 3) where relevant, re-select the appropriate BMI cut-off. During this round, members were also asked to suggest how each of the standards which had already met the inclusion criteria could be audited. Responses to the third iteration were analysed using the methodology described above and the distribution of scores and members' anonymised comments fed back to the group.

3.4. Agreement of standards

Twenty two CSG members representing all the disciplines in Table 1 attended a second meeting. Standards that had not yet met either the inclusion or exclusion criteria were reviewed at the meeting and consensus reached for each standard. CSG members were given the opportunity to suggest essential re-wording of the final agreed standards to maximise clarity. This feedback was reviewed by the project researcher and senior clinician at CMACE, who were responsible for final editing.

3.5. Levels of evidence

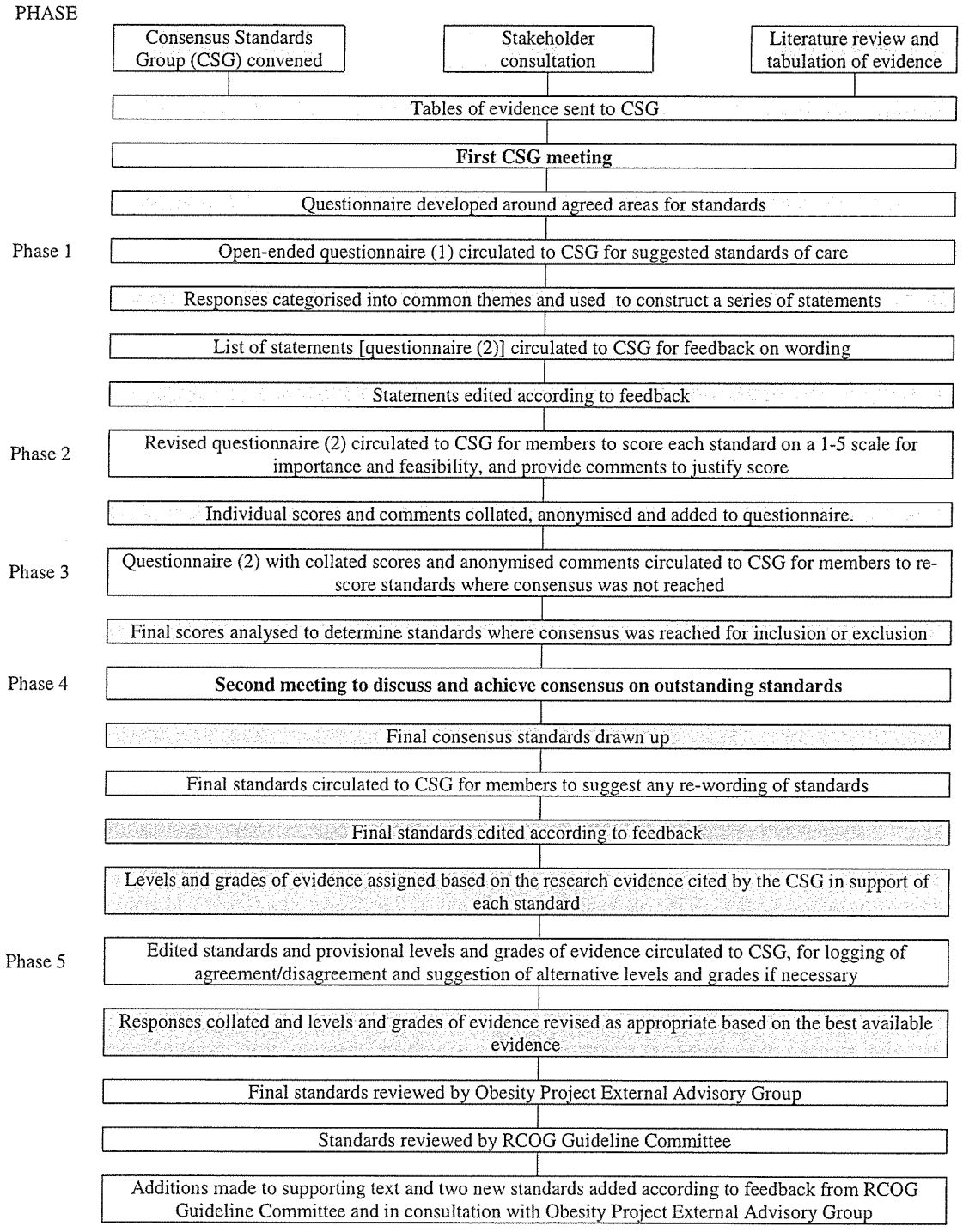
Levels of evidence were provisionally assigned to each standard based on supporting evidence cited by CSG members during the consensus process. The levels and grades of evidence were assigned according to the guidance for the development of RCOG Green-top Guidelines.[77] Since all standards were derived through a process of formal consensus, which corresponds to Evidence level 4, the lowest assigned grade of recommendation was D (refer to Appendix 2). CSG members reviewed the provisional levels and grades of evidence via an online questionnaire. Members logging any disagreement were prompted to recommend a revised level and/or grade of evidence, together with references supporting the revision(s).

All responses were reviewed by CMACE, and levels and grades of evidence were revised where relevant in light of any new supporting evidence. Any changes to the levels of evidence were reviewed and approved by the project's External Advisory Group.

3.6. Standards reviewed by RCOG Guideline Committee

The consensus standards developed by the CMACE Consensus Standards group were reviewed by the RCOG Guideline Committee. Revisions were made to the supporting text according to the committee's feedback and two additional standards relevant to women with obesity, identified from existing guidelines, were included. These standards have been footnoted in the text.

Figure 1. Process for developing the standards of maternity care for women with obesity: The modified Delphi Method



Members of the Consensus Standards Group by discipline

Discipline	Name	Organisation
Obstetrics (Chair)	Professor Ian Greer*	CEMACH /The Hull York Medical School
Anaesthesia	Dr Martin Dresner*	Leeds General Infirmary
Anaesthesia	Dr Anne McCrae	RCoA representative, Department of Anaesthesia, Critical Care and Pain Medicine, Royal Infirmary of Edinburgh
Dietetics	Fiona Taylor	Dietitians in Obesity Management (DOMUK)
Endocrinology	Dr Stephen Robinson*	Imperial College School of Medicine at St. Mary's Hospital, London
General Medicine (Obstetrics)	Dr Catherine Nelson-Piercy	RCP representative, St Thomas' Hospital, London
General Practice	Dr David Haslam	National Obesity Forum / Centre for Obesity Research at Luton & Dunstable Hospital
General Practice	Dr Victoria Tzortziou	RCGP representative
Lay representative	Alex Farrall*	Not applicable
Lay Representative	Stacey Grant*	Not applicable
Midwifery/Practice & Standards Development Advisor for RCM	Mervi Jokinen	RCM representative
Midwifery	Dr Jane Rogers*	Southampton University Hospitals Trust
Manual handling	Mary Muir	National Back Exchange
Neonatology	Dr Helen Budge*	Queens Medical Centre - Nottingham
Neonatology/Paediatrics	Dr Laura De Rooy	RCPCH representative, St Georges Hospital
Obstetrics	Professor Andrew Calder	Reproductive and Developmental Sciences, University of Edinburgh
Obstetrics	Dr Andrew Loughney	RCOG representative/ Royal Victoria Infirmary, Newcastle Upon Tyne
Obstetrics	Dr Daghni Rajasingam*	Guys and St. Thomas' NHS Trust, London
Obstetrics	Dr T G Teoh	St Mary's Hospital
Perinatal epidemiology	Dr Marian Knight*	National Perinatal Epidemiology Unit
Physiotherapy	Maria Jones	Central Manchester and Manchester Children's University Hospitals NHS Trust
Public Health	Dr Ruth Bell	FPH representative, Institute of Health and Society, Newcastle University, Medical School
Public Health	Dr Nicola Heslehurst*	Teesside University (Health and Social Care Institute)
Ultrasonography	Raj Dave	UCLH
Welsh representative/Midwifery	Karen Jewell	Cardiff and Vale Trust

*Consensus Standards Group and External Advisory Group member

APPENDIX 2: Levels and grades of evidence

Classification of evidence levels

Level	Evidence
1++	High-quality meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias
1-	Meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a high risk of bias
2++	High-quality systematic reviews of case–control or cohort studies or high quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal
2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a Moderate probability that the relationship is causal
2-	Case–control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal
3	Non-analytical studies; e.g. case reports, case series
4	Expert opinion/Formal consensus

Grades of evidence

Level	Evidence
A	At least one meta-analysis, systematic reviews or randomised controlled trial rated as 1++ and directly applicable to the target population; or A systematic review of randomised controlled trials or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++ directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+ directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+
	Good practice point Recommended best practice based on the clinical experience of the guideline development group

APPENDIX 3: Maternal and fetal risks in women with a BMI ≥30 kg/m^2 compared to women with a healthy BMI

Risk	Study	Pop.	Odds ratio [95% Confidence interval]*
Gestational diabetes	NW Thames 1989 – 97 [1] Aberdeen 1976 – 2005 [2]	287213 24241	3.6 [3.3-4.0] [a] 2.4 [2.2-2.7]
Hypertensive disorders	NW Thames 1989 – 97 [1] Aberdeen 1976 – 2005 [2]	287213 24241	2.1[1.9-2.5] [a] 3.3 [2.7-3.9]
Venous thromboembolism	Denmark 1980 – 2001 [3]	71729	9.7 [3.1-30.8]
Slower labour progress 4 – 10cm	USA 1995 – 2002 [4]	612	7 versus 5.4 hrs p<0.001
Caesarean	Meta-analysis of 33 studies		2.1 [1.9-2.3]
Emergency caesarean	NW Thames 1989 – 97 [1] Cardiff 1990 – 99 [5]	287213 8350	1.8 [1.7-1.9] 2.0 [1.2-3.5]
Postpartum haemorrhage	NW Thames 1989 – 97 [1] Aberdeen 1976 – 2005 [2]	287213 24241	1.4 [1.2-1.6] [a] 2.3 [2.1-2.6]
Wound infection	NW Thames 1989 – 97 [1]	287213	2.24 [1.91-2.64] [a]
Birth defects	Australia [6]	11252	1.6 [1.0-2.5]
Prematurity	Aberdeen 1976 – 2005 [2] Australia 1998 – 2002 [6]	24241 11252	1.2 [1.1-1.4] 1.2 [0.8-1.7]
Macrosomia	NW Thames 1989 – 97 [1] Sweden 1992 – 2001 [7]	287213 805275	2.4 [2.2-2.5] [a] 3.1 [3.0-3.3] [b]
Shoulder dystocia	Sweden 1992-2001 [7] Cardiff 1990 – 99 [5]	805275 8350	3.14 [1.86-5.31] [b] 2.9 [1.4-5.8]
Admission to NNU	NW Thames 1989 – 97 [1] Cardiff 1990 – 99 [5]	287213 8350	1.3 [1.3-1.4] [a] 1.5 [1.1-2.3]
Stillbirth	Meta-analysis of 9 studies [8]		2.1 [1.5-2.7]
Neonatal death	Denmark 1989 – 96 [9]	24505	2.6 [1.2-5.8]

[a] 99% Confidence intervals
[b] OR for morbidly obese
* Unless otherwise stated

References for Appendix 3

1. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 2001;25(8):1175-82.

2. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies. *BMC Public Health* 2007;7:168.

3. Larsen TB, Sorensen HT, Gislum M, Johnsen SP. Maternal smoking, obesity, and risk of venous thromboembolism during pregnancy and the puerperium: a population-based nested case-control study. *Thrombosis Research* 2007;120(4):505-9.

4. Vahratian A, Zhang J, Troendle JF, Savitz DA, Siega-Riz AM. Maternal prepregnancy overweight and obesity and the pattern of labor progression in term nulliparous women. *Obstetrics and Gynecology* 2004;104(5):943-951.

5. Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(6):768-772.

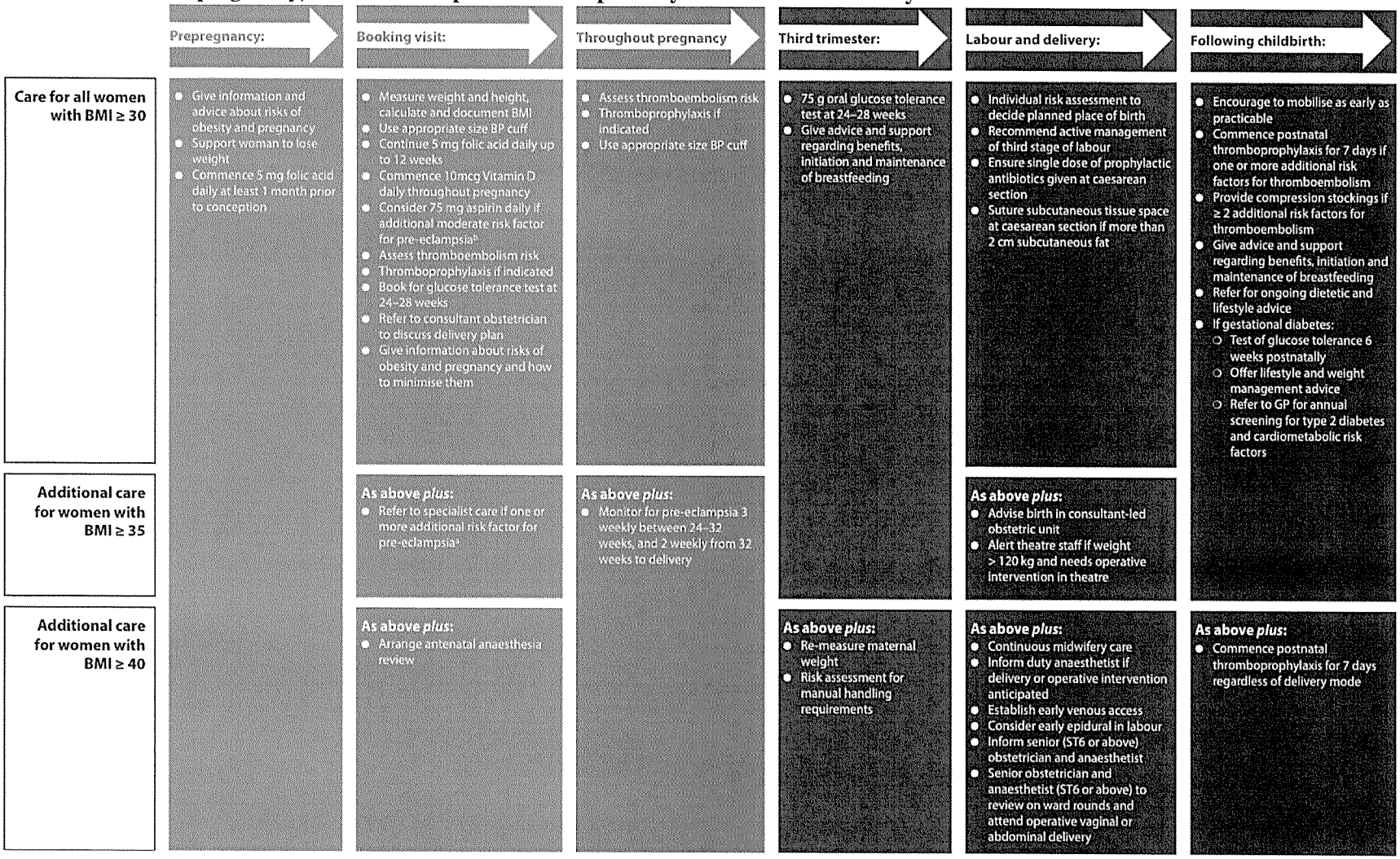
6. Callaway LK, Prins JB, Chang AM, McIntyre HD. The prevalence and impact of overweight and obesity in an Australian obstetric population. *Medical Journal of Australia* 2006;184(2):56-9.

7. Cedergren MI. Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstetrics and Gynecology* 2004;103(2):219-24.

8. Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, et al. Maternal obesity and risk of stillbirth: a metaanalysis. *American Journal of Obstetrics & Gynecology* 2007;197(3):223-8.

9. Kristensen J, Vestergaard M, Wisborg K, Kesmodel U, Secher NJ. Pre-pregnancy weight and the risk of stillbirth and neonatal death. *BJOG: An International Journal of Obstetrics and Gynaecology* 2005;112(4):403-408.

APPENDIX 4: Pre-pregnancy, antenatal and postnatal care pathway for women with obesity



[a]first pregnancy, previous pre-eclampsia, ≥10 years since last baby, ≥40 years, family history of pre-eclampsia, booking diastolic BP≥80mmHg, booking proteinuria ≥1+ on more than one occasion or ≥0.3g/24 hours, multiple pregnancy, and certain underlying medical conditions such as antiphosopholipid antibodies or pre-existing hypertension, renal disease or diabetes.

[b]first pregnancy, maternal age>40 years, family history of pre-eclampsia, multiple pregnancy

Anaesthesia, 2006, **61**, pages 36–48 doi:10.1111/j.1365-2044.2005.04433.x

REVIEW ARTICLE

Obesity and obstetric anaesthesia

K. Saravanakumar,[1] S. G. Rao[1] and G. M. Cooper[2]

1 Specialist Registrar, 2 Consultant Anaesthetist, Department of Anaesthetics, Birmingham Women's Hospital, Metchley Park Road, Edgbaston, Birmingham B15 2TG, UK

Summary

The prevalence of obesity continues to increase despite preventive strategies. Obese parturients are at increased risk of having either concurrent medical problems or superimposed antenatal diseases such as pre-eclampsia and gestational diabetes. Moreover, they have a tendency to labour abnormally contributing to increased instrumental delivery and Caesarean section. Obesity is a risk factor for anaesthesia related maternal mortality. Morbidly obese women must be considered as high-risk and deserve an anaesthetic consultation during their antenatal care. The significant difficulty in administering epidural analgesia should not preclude their use in labour. A more liberalised use of regional techniques may be a means to further reduce anaesthesia-related maternal mortality in the obese population. The mother's life should not be jeopardised to save a compromised fetus. Prophylactic placement of an epidural catheter when not contraindicated in labouring morbidly obese women would potentially decrease anaesthetic and perinatal complications associated with attempts at emergency provision of regional or general anaesthesia. Early mobilisation, aggressive chest physiotherapy and adequate pain control are essential components of effective postoperative care.

Correspondence to: K. Saravanakumar
E-mail: saravankumark@yahoo.com
Accepted: 18 September 2005

Obesity is a global health problem whose prevalence is increasing. The World Health Organization (WHO) characterised obesity as a pandemic issue whose prevalence is higher in women than in men [1]. Consequently, the anaesthetist is increasingly confronted with the problems of anaesthetising obese patients, and even more so the obstetric anaesthetist. Adding to the spectrum of medical and surgical pathologies, obesity is also associated with an increased incidence of antenatal disorders. A thorough understanding of physiology, pathophysiology, associated conditions, their complications and the implications for analgesia and anaesthesia should place the anaesthetist in a better position to care for these patients.

Definition

Obesity is often defined simply as a condition of abnormal or excessive fat accumulation in adipose tissue to the extent that health may be impaired [2]. The underlying process is positive energy balance and weight gain. Obesity is often expressed with reference to body mass index (BMI).

$$\text{Body mass index} = \text{weight (in kg)}/\text{height}^2 \text{ (in m)}.$$

Though BMI is a useful measure of prevalence and associated health risks of obesity, it does not account for the wide variation in the distribution of fat and may not correspond to the same degree of fatness in different individuals. WHO classifies obesity primarily based on the association between BMI and mortality (Table 1) [1].

Epidemiology

The prevalence of obesity is increasing at an alarming rate in both developed and developing countries. In pregnant women in the United States at the end of the last century, the prevalence ranged from 18.5% to 38.3% according to the cohort studied and the cut-off point used to define overweight [3]. A Brazilian study at a similar time reported the prevalence of obesity in pregnancy to be 5.5% [4]. The Health Survey of England published in

maternal morbidity and mortality significantly [11, 12]. Caesarean section, despite being lower abdominal surgery, potentially leads to reduced lung volume and capacities compared to non-obese patients [13].

Cardiovascular system

Pregnancy is associated with wide-ranging cardiovascular changes in line with increased oxygen demand. Obesity induced pathological changes have profound effects on cardiac, endothelial and vascular function. Unlike the respiratory system, where pregnancy offers some favourable effects in obese patients, the cardiovascular system is further stressed. The endocrinological, inflammatory and microvascular changes associated with obesity remain and are further augmented in pregnancy [14–16]. Table 3 summarises the changes in normal pregnancy, obese patients and obese pregnant women [14–20].

The extent of cardiovascular pathological changes secondary to obesity is dependent on the duration of obesity and its severity [18]. Any extra amount of fat deposited in the body demands its share of cardiac output. Every 100 g of fat deposited increases the cardiac output by 30–50 $ml.min^{-1}$. This is also accompanied by an increase in blood volume. Volume load initially brings about left ventricular hypertrophy and then subsequently the myocardium starts to dilate against the increased pressure overload. The pressure overload is secondary to increased sympathetic activity due to the potentiating effects of hormones such as leptin, insulin and some inflammatory mediators. The heart rate increases in line with elevated cardiac output, thereby decreasing the diastolic interval and thus the time for myocardial perfusion. Impaired myocardial diastolic relaxation leads to diastolic dysfunction. If fat deposition occurs in myocardial tissue, then conduction and contractility can be seriously affected [18, 19]. Hence, it is not uncommon to see systolic, diastolic or both systolic and diastolic dysfunction of the left ventricle. Right ventricular failure can be present in patients with pulmonary hypertension and OSA. Congestive heart failure is a consequence in the presence of any additional stress [9, 10, 16, 18, 19].

Insulin resistance and dyslipidaemias affect the vascular tree and increased inflammatory mediators such as C-reactive protein, IL-6, and TNF-α affect endothelial function. This endothelial dysfunction in pregnant women may predispose to the development of pregnancy-induced hypertension [15, 16, 19, 21]. The well-known effect of an enlarged uterus compressing abdominal major vessels and causing supine hypotension syndrome (SHS) can also be seen in obese patients. This can be greatly exacerbated in obese parturients where a large panniculus adds to the uterine compression. The problem may extend postoperatively if the panniculus is large enough to cause compression of the vessels by itself. Tseuda *et al.* reported two cases of sudden death on assuming the supine position in morbidly obese patients, which they attributed to circulatory changes brought about by changes in their position [22]. Drenick & Fisler also reported cases of postoperative cardiac arrest in obese surgical patients. There was no pathology found at autopsy to explain the cardiac arrest [23].

Table 3 Changes in the cardiovascular system. Table shows the general trend. Extent of variability in each parameter depends on duration, degree of obesity and associated co-morbid states.

Parameter	Pregnancy	Obesity	Combined
Heart rate	↑	↑↑	↑↑
Stroke volume	↑↑	↑	↑
Cardiac Output	↑↑	↑↑	↑↑↑
Cardiac Index	↑ or ↔	↔	↔ or ↓
Haematocrit	↓↓	↑	↓
Blood volume	↑↑	↑	↑
Systemic vascular resistance	↓↓	↑	↔ or ↓
Mean arterial pressure	↑	↑↑	↑↑
Supine hypotension	Present	Present	↑↑
Left ventricular morphology	Hypertrophy	Hypertrophy and dilation	Hypertrophy and dilation
Sympathetic activity	↑	↑↑	↑↑↑
Systolic function	↔	↔ or ↓	↔ or ↓
Diastolic function	↔	↓	↓
Central venous pressure	↔	↑	↑↑
Pulmonary wedge pressure	↔	↑↑	↑↑
Pulmonary hypertension	Absent	May be present	May be present
Pre-eclampsia	↔	n/a	↑↑

↑ = increase, ↓ = decrease, ↔ = no change (multiple arrows represent the degree of intensity). n/a = not applicable.

Gastrointestinal changes

Both anatomical and hormonal changes increase the incidence and severity of gastric reflux in pregnant women. Hiatus hernia is more common in obese patients and obesity itself increases the risk of aspiration under anaesthesia. When pregnancy is associated with obesity, the likelihood of regurgitation and aspiration substantially increases. Roberts and Shirley studied obese and non-obese pregnant women in labour; the gastric volume in obese parturients was five times greater than in controls [24].

Endocrine and reproduction

Because obese girls reach critical mass earlier than normal weight girls, they tend to reach menarche earlier. An *ob* protein called leptin is implicated in the mechanism. Obesity-induced changes in the reproductive system mean there is a reduced likelihood that these women will become pregnant [25]. Despite the potential

contrasts with an incidence of difficult intubation in an obese population as high as 15.5% [55]. In his institutional experience, Dewan [7] reports the incidence as high as 33% in morbidly obese parturients. Interestingly, a 6-year review of failed intubations in obstetric patients in a UK region reported 36 cases of failed intubation and the average BMI of these women was found to be 33 [53]. So it is evident that difficult or failed tracheal intubation in obese parturients is very high and optimal assessment and management of the airway cannot be overemphasised in this population.

Though there are no bony differences between the pregnant and non-pregnant population, obese and non-obese patients, fat deposition in obese and soft tissue changes during pregnancy do influence the airway. Operational factors such as poor head positioning, cricoid pressure [56] and anxiety contribute to the difficulty on occasion. In addition, pregnancy induced hypertension, upper respiratory tract infection, stridor and voice changes may suggest the presence of airway oedema. Weight gain in excess of 15 kg during pregnancy has been shown to be associated with an increase in suboptimal laryngoscopic views [57].

Although not totally reliable, assessment of oropharyngeal structures using the Mallampatti classification has been shown to strongly correlate with the prediction of difficult intubation in obstetric anaesthesia [58, 59]. Other features shown to be significant include short neck, receding mandible and protruding maxillary incisors [58]. The combination of two tests (Mallampatti and thyromental distance), albeit in a small study of 80 obstetric patients receiving general anaesthesia, has been shown to be 100% sensitive with 70% positive predictor value [59]. These tests can be done in less than 1 min; hence they are also useful in an emergency scenario. A previous uneventful general anaesthetic for either obstetric or non-obstetric reasons may not be helpful because of weight gain. However, previous anaesthetic charts inform of laryngoscopic view. In cases of documented difficult intubation, further airway imaging (X-ray and computerised tomography) is questionable as the combined clinical and radiological measurements only improve predictability of a difficult airway by 0.04% compared to clinical assessments alone [60]. Anaesthesia for both emergency and elective scenarios should be planned in advance. It is appropriate to involve patients in the decision-making process for safe delivery of the fetus.

Respiratory system

The likelihood of OSA has been alluded to, but it is often under-diagnosed in women of childbearing age [11]. Normal women in late pregnancy have difficulty with sleep maintenance and spend less time in the supine position. It is possible that, inasmuch as complaints of difficulty in sleeping and daytime fatigue are common, women suffering from OSA are not identified. Careful history taking may help diagnose OSA. Prompt diagnosis by polysomnography and treatment with continuous positive airway pressure may be beneficial. Pulmonary hypertension and right heart failure need to be excluded in parturients with OSA [12, 61]. Measurement of oxygen saturation by pulse oximetry, both in sitting and supine positions, may provide evidence of airway closure during normal tidal volume ventilation, thereby identifying candidates for postoperative oxygen administration. Pre-operative arterial blood gas examination provides information regarding the current status of ventilation and oxygenation. Detailed pulmonary investigations including chest X-ray should be reserved for those with more severe respiratory disease. Pre-operative antibiotics and chest physiotherapy are ideally reserved for patients with concurrent chest infection.

Cardiovascular system

Cardiovascular co-morbidities such as hypertension, ischaemic heart disease and heart failure dominate the clinical picture in the obese population and these can co-exist in obese parturients. Nearly 40% of the obese population experience angina without demonstrable coronary artery disease [62]. Hence, routine electrocardiograph recording may be useful. Cardiologists should be involved early in the care of symptomatic morbidly obese parturients to investigate and optimise the disease status wherever appropriate.

Gastrointestinal and endocrine systems

Gastro-oesophageal reflux and diabetes mellitus are the most commonly seen disorders [28]. Any previous laboratory investigations such as fasting blood glucose concentration and liver function tests should be noted. If there is any abnormality of liver function, HELLP syndrome should be ruled out.

Though aggressive prophylaxis against acid aspiration is advocated for all obese mothers undergoing Caesarean section [24, 63], there is a lack of conclusive evidence for starvation policies and prophylaxis during labour. Current evidence suggests avoiding solids and semisolids once a woman is in active labour or requests analgesia [64]. Sodium citrate and ranitidine remain the most commonly used drugs for acid aspiration prophylaxis in the UK [65].

Practical considerations

Obese parturients share a battery of technical difficulties along with their non-pregnant counterparts. Blood pressure measurement will require an appropriate sized cuff; otherwise both systolic and diastolic readings will be

inadvertent dural puncture is smaller [81]. Although the epidural space may be deeper in overweight people, the majority of studies report that only a few have an epidural space deeper than 8 cm [75, 78]. Hence it seems appropriate to use a standard needle to identify the epidural space on the first attempt. A successfully placed catheter can easily be dislodged by the drag of the back pad of fat when parturients move around in bed. Wasson postulates that a 6 cm lateral movement of skin site relative to the spine would drag 2 cm of catheter out of the epidural space [82]. Moreover, the catheter is subjected to a drag when the flexed back is relaxed immediately after a successful placement. These should be taken into consideration when deciding the length of catheter to be left in the space for a successful working epidural. The other common reasons for a successfully placed catheter to fail include inadequate dose of local anaesthetic, poor drug spread, misplacement of the catheter, septae within the epidural space and fetal malpositioning leading to more stimulation. With increased operative intervention in obese parturients, it is prudent to make sure that the epidural is working well and, if not, to replace the catheter at the earliest possible opportunity. Hodgkinson *et al.* have shown that BMI and weight are the major determinants of cephalad spread of epidural anaesthesia and that in obese patients the sitting position reduced cephalad spread [83, 84]. However, Milligan *et al.* showed no difference in the spread of epidural analgesia between obese and non-obese patients requesting labour analgesia, either in the sitting or in the lateral position [85].

Entonox can be a useful adjunct. Other forms of inhalational analgesia involving isoflurane and desflurane provide better analgesia when compared to nitrous oxide alone but cause more sedation and amnesia. Whereas intramuscular opioid injections may be unreliable, patient controlled intravenous analgesia has been used successfully in obese patients. However, opioids in labour have been associated with maternal and fetal side-effects [86]. All these methods potentially cause maternal drowsiness and lead to airway obstruction, thus inherently carrying a risk to the obese parturients.

Anaesthesia for Caesarean section

Obesity and Caesarean section have been identified as independent risk factors for maternal morbidity and mortality [28]. In *Why Mothers Die 2000–02*, 35% of all the women who died were obese, 50% more than in the general population [49]. Analysis of direct maternal deaths due to anaesthesia reported in the confidential enquiries from 1979 to 2002 reveals the dominance of deaths under general compared to regional anaesthesia (Table 4 [49, 87–93]). Hawkins, in her analysis of maternal deaths in the United States, also reported that the absolute number of deaths due to complications of general anaesthesia, although small, is not decreasing over time [94] (Fig. 2). Regional anaesthesia is a safer option than general anaesthesia for delivery of the fetus [49, 94]. The principles in the anaesthetic management of these patients include

- regional anaesthesia unless contraindicated;
- care provided by experienced medical personnel (both anaesthetist and obstetrician);
- anticipation of problems and effective preparation in terms of equipment, monitoring and personnel;
- general anaesthesia, if required should be delivered with tracheal intubation and controlled ventilation;
- postoperative care that includes close monitoring, early mobilisation, and physiotherapy; a high dependency setting may achieve this most appropriately;
- judicious use of neuraxial, oral and intravenous opioids for postoperative pain relief.

Table 4 Direct maternal deaths due to anaesthesia by types of anaesthesia in United Kingdom 1979–2002. Derived from CEMD reports. Since 1979, maternal deaths are reported as direct and indirect.

Year	Total (*n*)	GA (*n*)	RA (*n*)
2000–02	6	6	0
1997–99	3	2	1
1994–96	1	0	1
1991–93	8	7	1
1988–90	4	3	1
1985–87	8	7	1
1982–84	18	17	1
1979–81	22	22	0

GA, general anaesthesia; RA, regional anaesthesia.

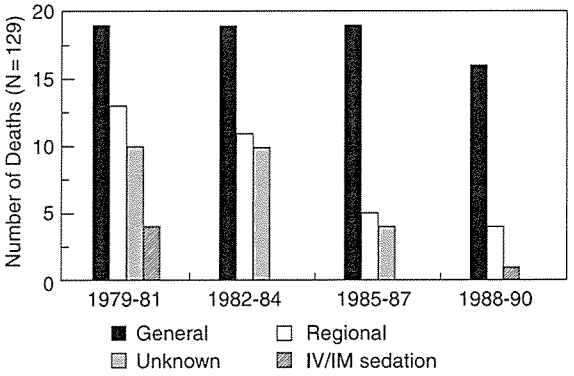


Figure 2 Anaesthesia-related maternal deaths by types of anaesthesia, United States 1979–90 [94]. Reprinted with permission from *Anesthesiology*.

an alternative method of securing the airway. Awake intubation poses its own problems. The nasal route is not recommended because of the characteristic engorgement of nasal mucosa during pregnancy. Hypertension and catecholamine release during the procedure could adversely affect uterine blood flow. Moreover, it is difficult to perform in urgent scenarios such as maternal haemorrhage or fetal distress [7]. In any of these circumstances, the mother's life should not be endangered to save a compromised fetus.

In an otherwise normal airway, administration of general anaesthesia begins with effective denitrogenation of the lungs, as obese parturients desaturate rapidly compared to normal patients. Denitrogenation can be performed by either 3 min of tidal breathing with 100% oxygen or by four maximal breaths with 100% oxygen. There is little evidence to support one technique over the other [107, 108]. Hence, it is reasonable that urgency of Caesarean section dictates the technique of denitrogenation. The choice of intravenous induction agent is relatively unimportant if there are no co-existing medical problems. Dewan suggests that at least 4 $mg.kg^{-1}$ of thiopental (up to a maximum dose of 500 mg) should be used if chosen, to avoid the risk of maternal awareness, hypertension and decreased uterine blood flow during light anaesthesia [7]. Administration of a larger dose may be associated with delayed arousal in the event of failed intubation. Succinylcholine remains the muscle relaxant of choice for intubation. Bentley *et al.* observed increased pseudo-cholinesterase activity in obese non-pregnant patients. They recommended that anaesthetists should administer succinylcholine on the basis of total rather than lean body weight in adult patients [109]. However, pregnancy reduces pseudo-cholinesterase activity. Hence the dose of succinylcholine 1.0–1.5 $mg.kg^{-1}$ up to a maximum of 200 mg is reasonable [7]. Tracheal intubation should be confirmed by the repetitive and characteristic waveform of capnography in addition to auscultation. Endobronchial intubation should also be promptly recognised and corrected to avoid intra- and postoperative pulmonary complications. In the event of failure to intubate the trachea after rapid sequence induction, it is imperative to institute a failed intubation drill without delay. Repeated attempts and a second dose of succinylcholine are seldom beneficial and often detrimental. The primary objective in the management of failed intubation is to ensure adequate maternal oxygenation despite the concerns of fetal well-being or risk of regurgitation.

In morbidly obese patients, a relatively high-inspired oxygen concentration may be necessary compared to non-obese counterparts, necessitating use of high concentrations of volatile agents. Under general anaesthesia, functional residual capacity (FRC) decreases because of the supine position, use of volatile agents, muscle relaxants and cephalad retraction of a panniculus, leading to early closure of small airways, exaggerating hypoxaemia. Various techniques such as higher tidal volumes, high inspired oxygen and the use of positive end-expiratory pressure (PEEP) have been used to maintain adequate oxygenation. In high-risk cases, emptying of the stomach and administration of sodium citrate via an orogastric tube before extubation may be helpful. Extubation should be attempted only in awake patients with adequate reversal of neuromuscular blockade, as there have been incidences of failed extubation in obese parturients [50, 51]. A 30° head-up tilt is a more favourable position for extubation than supine in the obese population [110].

Postoperative care

Obese parturients are at increased risk of postoperative complications such as hypoxaemia, atelectasis and pneumonia, deep vein thrombosis and pulmonary embolism, pulmonary oedema, postpartum cardiomyopathy, postoperative endometritis and wound complications such as infection and dehiscence [50, 51]. Early mobilisation, thromboprophylaxis, aggressive chest physiotherapy and adequate pain control are the key to the success of effective postoperative care.

In the recovery room, critical respiratory events (desaturation, hypoventilation and airway obstruction) occur twice as commonly in the obese compared to non-obese [111]. Computerised tomography has demonstrated that obesity predisposes to the formation of pulmonary atelectasis *per se* and even more so under general anaesthesia, persisting into the postoperative period [112]. Moreover, even after spinal anaesthesia, there is a BMI dependent decrease in respiratory function [113]. Hence, these critical respiratory events may not be benign and can lead to postoperative pulmonary morbidity. Nursing in the reclined position and oxygen supplementation can potentially reduce critical respiratory events. Early mobilisation has been shown to improve the respiratory volumes in the immediate postoperative phase [113]. Interestingly, Hood and Dewan found that, in morbidly obese women, all postpartum complications occurred in those undergoing Caesarean section and not in those having vaginal delivery [51]. In general surgical patients, pre-operative pulmonary function tests have been shown to predict postoperative pulmonary complications in obese patients [77] and an extrapolation for obese parturients may be true.

Pain control should be adequate in the postoperative period to facilitate mobilisation and chest physiotherapy, as it is one of the determinants of postoperative maternal morbidity. Epidural analgesia has been shown to improve

27 Castro LC, Avina RL. Maternal obesity and pregnancy outcomes. *Current Opinion in Obstetrics and Gynecology* 2002; **14**: 601–6.
28 Weiss JL, Malone FD, Emig D, *et al.* Obesity, obstetric complications and cesarean delivery rate – a population-based screening study. *American Journal of Obstetrics and Gynecology* 2004; **190**: 1091–7.
29 Chauhan SP, Magann EF, Carroll CS, *et al.* Mode of delivery for the morbidly obese with prior cesarean delivery: vaginal versus repeat cesarean section. *American Journal of Obstetrics and Gynecology* 2001; **185**: 349–54.
30 Sheiner E, Levy Menes TS, *et al.* Maternal obesity as an independent risk factor for caesarean delivery. *Paediatric and Perinatal Epidemiology* 2004; **18**: 196–201.
31 Martin JN Jr, May WL, Rinehart BK, Martin RW, Magann EF. Increasing maternal weight: a risk factor for preeclampsia/eclampsia but apparently not for HELLP syndrome. *Southern Medical Journal* 2000; **93**: 686–91.
32 Durnwald CP, Ehrenburg HM, Mercer BM. The impact of maternal obesity and weight gain on vaginal birth after cesarean section success. *American Journal of Obstetrics and Gynecology* 2004; **191**: 954–7.
33 Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *British Journal of Obstetrics and Gynaecology* 2005; **112**: 768–72.
34 Carroll CSSr, Magann EF, Chauhan SP, Klauser CK, Morrison JC. Vaginal birth after cesarean section versus elective repeat cesarean delivery: weight-based outcomes. *American Journal of Obstetrics and Gynecology* 2003; **188**: 1516–22.
35 Myles TD, Gooch J, Santolaya J. Obesity as an independent risk factor for infectious morbidity in patients who undergo cesarean delivery. *Obstetrics and Gynecology* 2002; **100**: 959–64.
36 Andreasen KR, Andersen ML, Schant AL. Obesity and pregnancy. *Acta Obstetricia et Gynecologica Scandinavica* 2004; **83**: 1022–9.
37 Carter AS, Baker CW, Brownell KD. Body mass index, eating attitudes and symptoms of depression and anxiety in pregnancy and the postpartum period. *Psychosomatic Medicine* 2000; **62**: 264–70.
38 Ehrenburg HM, Mercer BM, Catalano PM. The influence of obesity and diabetes on the prevalence of macrosomia. *American Journal of Obstetrics and Gynecology* 2004; **191**: 964–8.
39 Watkins ML, Rasmussen SA, Honein MA, Botto LD, Moore CA. Maternal obesity and risk for birth defects. *Pediatrics* 2003; **111**: 1152–8.
40 Stephansson O, Dickman PW, Johansson A, Cnattingius S. Maternal weight, pregnancy weight gain and the risk of antepartum stillbirth. *American Journal of Obstetrics and Gynecology* 2001; **184**: 463–9.
41 Wolfe HM, Sokol RJ, Martier SM, Zador IF. Maternal obesity: a potential source of error in sonographic prenatal diagnosis. *Obstetrics and Gynecology* 1990; **76**: 339–42.
42 Li R, Jewell S, Grummer-Strawn L. Maternal obesity and breast-feeding practices. *American Journal of Clinical Nutrition* 2003; **77**: 931–6.
43 Rasmussen KM, Kjolhede CL. Prepregnant overweight and obesity diminish the prolactin response to suckling in the first week postpartum. *Pediatrics* 2004; **113**: 465–71.
44 Arenz S, Ruckerl R, Koletzko B, *et al.* Breast feeding and childhood obesity – a systematic review. *International Journal of Obesity* 2004; **28**: 1247–56.
45 Parsons TJ, Power C, Manor O. Fetal and early life growth and body mass index from birth to early adulthood in 1958 British Cohort: longitudinal study. *British Medical Journal* 2001; **323**: 1331–5.
46 Hytten FE. Weight gain in pregnancy. In: Hytten F, Chamberlain G, eds. *Clinical Physiology in Obstetrics.* Oxford: Blackwell Scientific Publications, 1991: 173–203.
47 Harris HE, Ellison GTH, Richter LM, Wet TD, Levin J. Are overweight women at increased risk of obesity following pregnancy? *British Journal of Nutrition* 1998; **79**: 489–94.
48 Endler GC, Mariona FG, Sokol RJ, Stevenson LB. Anesthesia related maternal mortality in Michigan, 1972–84. *American Journal of Obstetrics and Gynecology* 1988; **159**: 187–93.
49 Cooper GM, McClure JH. Anaesthesia. In: *Why Mothers Die, 2000–2.* Sixth report on confidential enquiries into maternal deaths in the United Kingdom. London: RCOG press, 2004: 122–33.
50 Jordan H, Perlow MD, Mark A, Morgan MD. Massive maternal obesity and perioperative cesarean morbidity. *American Journal of Obstetrics and Gynecology* 1994; **170**: 560–5.
51 Hood DD, Dewan DM. Anesthestic and obstetric outcome in morbidly obese parturients. *Anesthesiology* 1993; **79**: 1210–8.
52 Hawthorne L, Wilson R, Lyons G, Dresner M. Failed intubation revisited: a 17-yr experience in a teaching Maternity unit. *British Journal of Anaesthesia* 1996; **76**: 680–4.
53 Barnardo PD, Jenkins JG. Failed tracheal intubation in obstetrics: a 6 year review in a UK region. *Anaesthesia* 2000; **55**: 685–94.
54 Samsoon GL, Young JR. Difficult tracheal intubation: a retrospective study. *Anaesthesia* 1987; **42**: 487–90.
55 Juvin P, Lavaut E, Dupont H, *et al.* Difficult tracheal intubation is more common in obese than lean patients. *Anesthesia and Analgesia* 2003; **97**: 595–600.
56 Noguchi T, Koga K, Shiga Y, Shigematsu A. The gum elastic bougie eases tracheal intubation while applying cricoid pressure compared to a stylet. *Canadian Journal of Anesthesia* 2003; **50**: 712–7.
57 Sankar KB, Krishna S, Moseley HSL. Airway changes during pregnancy. *Anesthesiology* 1997; **87**: A895.
58 Rocke DA, Murray WB, Rout CC, Gouws E. Relative risk analysis of factors associated with difficult intubation in obstetric anesthesia. *Anesthesiology* 1992; **77**: 67–73.
59 Merah NA, Foulkes-Crabbe DJ, Kushimo OT, Ajayi PA. Prediction of difficult laryngoscopy in a population of Nigerian obstetric patients. *West African Journal of Medicine* 2004; **23**: 38–4.

92 Anonymous. Deaths Associated with Anaesthesia. In: *Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1982–4*. London: Her Majesty's Stationary Office, 1989: 96–106.
93 Anonymous. Deaths Associated with Anaesthesia. In: *Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1979–81*. London: Her Majesty's Stationary Office, 1986: 83–94.
94 Hawkins JL, Koonin LM, Palmer SK, Susan K, Gibbs CP. Anesthesia-related deaths during obstetric delivery in the United States, 1979–90. *Anesthesiology* 1997; **86**: 277–84.
95 Hodgkinson R, Husain FJ. Caesarean section associated with gross obesity. *British Journal of Anaesthesia* 1980; **52**: 919–23.
96 Wong CA, Norris MC. Acute situations. *Obstetrics*. In: Raj P, ed. *Textbook of Regional Anesthesia*. Philadelphia: Churchill Livingstone, 2002: 471–504.
97 Hogan QH, Prost RBS, Kulier A, Taylor ML, Liu S, Mark L. Magnetic resonance imaging of cerebrospinal fluid volume and the influence of body habitus and abdominal pressure. *Anesthesiology* 1996; **84**: 1341–9.
98 Greene NM. Distribution of local anesthetics within the subarachnoid space. *Anesthesia and Analgesia* 1985; **64**: 715–30.
99 Pitkanen MT. Body Mass and spread of spinal anesthesia with bupivacaine. *Anesthesia and Analgesia* 1987; **66**: 127–31.
100 Norris MC. Height, weight and spread of subarachnoid hyperbaric bupivacaine in term parturient. *Anesthesia and Analgesia* 1988; **67**: 555–8.
101 McCulloch WJD, Littlewood DG. Influence of obesity on spinal analgesia with isobaric 0.5% bupivacaine. *British Journal of Anaesthesia* 1986; **58**: 610–4.
102 Taivainen T, Tuominen M, Rosenberg PH. Influence of obesity on the spread of spinal analgesia after injection of plain 0.5% bupivacaine at the L3–4 or L4–5 interspace. *British Journal of Anaesthesia* 1990; **64**: 542–6.
103 Milligan KR, Carp H. Continuous spinal anaesthesia for caesarean section in the morbidly obese. *International Journal of Obstetric Anesthesia* 1992; **1**: 111–3.
104 Kuczkowski KM, Benumof JL. Repeat cesarean section in a morbidly obese parturient: a new anesthetic option. *Acta Anaesthesiologica Scandinavica* 2002; **46**: 753–4.
105 NHS. *Maternity Statistics, England: 2002–03*. Bulletin 10; Government Statistical Services. London: Department of Health, 2004.
106 Cohn AI, Hart RT, McGraw SR, Blass NH. The Bullard laryngoscope for emergency airway management in a morbidly obese parturient. *Anesthesia and Analgesia* 1995; **81**: 872–3.
107 Norris MC, Dewan DM. Preoxygenation for cesearean section: a comparison of two techniques. *Anesthesiology* 1985; **62**: 827–9.
108 Goldberg ME, Norris MC, Larijani GE, Marr AT, Seltzer JL. Preoxygenation in the morbidly obese: a comparison of two techniques. *Anesthesia and Analgesia* 1989; **68**: 520–2.
109 Bentley JB, Borel JD, Vaughan RW, *et al.* Weight, pseudocholine esterase activity and succinylcholine requirement. *Anesthesiology* 1982; **57**: 48–9.
110 Vaughan RW, Bauer S, Wise L. Effect of position (semi-recumbent versus supine) on postoperative oxygenation in markedly obese. *Anesthesia and Analgesia* 1976; **55**: 37–41.
111 Ross DK, Cohen MM, Wigglesworth DF, Deboer DP. Critical respiratory events in the postanesthesia care unit. *Anesthesiology* 1994; **81**: 410–8.
112 Eichenberger AS, Proietti S, Wicky S, *et al.* Morbid obesity and postoperative pulmonary atelectasis: An underestimated problem. *Anesthesia and Analgesia* 2002; **95**: 1788–92.
113 von Ungern-Sternberg BS, Regli A, Bucher E, Reber A, Schneider MC. Impact of spinal anaesthesia and obesity on maternal respiratory function during elective caesarean section. *Anaesthesia* 2004; **59**: 743–9.
114 Ballantyne JC, Carr DB, de Ferranti S, *et al.* The comparative effects of postoperative analgesic therapies on pulmonary outcome: cumulative meta-analyses of randomised, controlled trials. *Anesthesia and Analgesia* 1998; **86**: 598–612.
115 Wheatley RG, Schug SA, Watson D. Safety and efficacy of postoperative epidural analgesia. *British Journal of Anaesthesia* 2001; **87**: 47–61.
116 Levin A, Klein S, Brolin R, Pitchford DE. Patient controlled analgesia for morbidly obese patient: An effective modality if used correctly. *Anesthesiology* 1992; **76**: 857–8.
117 Drife J. Thrombosis and thromboembolism. In: *Why Mothers Die, 2000–2*. Sixth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. London: RCOG press, 2004: 61–78.
118 Kaufman I, Bondy R, Benjamin A. Peripartum cardiomyopathy and thromboembolism; anesthetic management and clinical course of an obese, diabetic patient. *Canadian Journal of Anesthesia* 2003; **50**: 161–5.
119 Shnaider R, Ezri T, Szmuk P, *et al.* Combined spinal-epidural anesthesia for cesarean section in a patient with peripartum dilated cardiomyopathy. *Canadian Journal of Anesthesia* 2001; **48**: 681–3.
120 Wall PD, Deucy EE, Glantz JC, Pressman EK. Vertical skin incisions and wound complications in the obese parturient. *Obstetrics and Gynecology* 2003; **102**: 952–6.
121 Galtier-Dereure F, Montpeyroux F, Boulot P, Bringer J, Jaffiol C. Weight excess before pregnancy: complications and cost. *International Journal of Obesity Related Metabolic Disorders* 1995; **19**: 443–8.

6

Meeting of Department of Anaesthesia and Maternity Services (midwives and obstetricians) 17th December 2014

Present

Chair:

Anaesthetists: , Chris Smith

Obstetricians:

Background

Concern has been expressed about the criteria for acceptance of patients for delivery at Masterton Hospital, specifically the 'cut-off' BMI.

The competing issues of providing care close to home and safely were discussed.

It was noted that a retrospective case notes audit of anaesthesia for caesarean section at Masterton Hospital with respect to BMI was being conducted. *Analysis (after the meeting) has demonstrated that:*

- *5% of caesarean section patients exceeded the limit of BMI of 40*
- *Those patients had an increased incidence of anaesthesia complications:*
    - *29% needed GA compared with 6% of all patients*
    - *33% had a noted high block in PACU (one patient with BMI of 37 also had a documented high block in PACU, none under 37)*

Summary of agreed policy

1. That the Maternity 'Referral Guidelines' (guidelines for consultation with obstetric and related medical services) will be followed.
2. For BMI, the guidelines state:
    a. Obesity (BMI > 35, < 40): consultation with referral services (in WDHB this will be the obstetrician)
    b. Morbid obesity (BMI > 40): transfer of care to referral services (in WDHB this will be the obstetrician)
3. Patients with a BMI > 40 will be advised that delivery must take place in a DHB with higher level support services (Hutt or Capital Coast).

7

Anaesthesia Staff Meeting WDHB 20th March 2015

Present: , Chris Smith,
Leave:

5. Acceptance criteria at WDHB: the current understanding is to be circulated: The limitations placed on patients accepted for anaesthesia within Masterton Hospital are as follows, and reflect the capabilities and equipment available:

No patients under 3 years of age
No patients with a BMI >45
No obstetric patients with a BMI > 40 at booking
No patients of ASA 4 and 5 class, or complex ASA3 patients (ie no patients with significant co-morbidities relevant to anaesthesia).
No patients who will require ICU post-operatively.