Induction of labour and intrapartum care in obese women

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The rising incidence of obesity in pregnancy has a significant impact on the provision of health services around the world. Due to the pathophysiological processes associated with the condition, the obese pregnant woman is at increased risks of induction of labour, caesarean section, post-partum haemorrhage, infection, longer hospital stay, macrosomia and higher perinatal morbidity and mortality. Labour is more likely to be prolonged and dysfunctional, leading to the requirements for higher doses of oxytocin and increased risks of operative deliveries and morbidity. A multidisciplinary approach to the planning of antenatal, intrapartum and postnatal care is vital to ensure a safe outcome for the obese pregnant woman and her baby. The need for supervision and attendance by senior obstetric staff is increased, emphasising the need to identify the appropriate place of birth for this high-risk group of women, placing a significant strain on the resources of health-care providers.

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Introduction

The worldwide prevalence of obesity has doubled in the last 30 years, with approximately 300 million females above the age of 20 years categorised as overweight (body mass index (BMI) between 25.0 and 29.9 kg/m²) or heavier (BMI > 30 kg/m²) [1–3]. Obese pregnant women not only pose a challenge during their antenatal care but are also at considerable risk during their labour and delivery.

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A number of observational studies have shown a higher incidence of intrapartum and post-partum complications among obese women, compared to those with a normal BMI [4].

Preparation for labour is of vital importance and involves a multidisciplinary approach to the obese woman’s antenatal care. The place of delivery (for example, a tertiary institution) is a key factor to consider. Caring for the obese parturient and the associated challenges place increased demands on staff and resources across maternity and delivery wards, operating theatres and neonatal units [5]. Awareness of risks and up-to-date evidence-based clinical practice are essential in ensuring safe outcomes and cost-effective utilisation of resources.

**Preterm birth**

Preterm birth is associated with significant neonatal mortality, morbidity and long-term disability [6]. Obesity increases the risk of iatrogenic preterm delivery related to co-morbidities such as pre-eclampsia and gestational diabetes [7–10]. The evidence is not so clear with regard to the risk of spontaneous preterm delivery in obese women. Whilst there is an increased risk of preterm delivery, mostly due to associated co-morbidities, they are iatrogenic, rather than due to the spontaneous onset of labour [8,10]. Spontaneous onset of labour in obese women has been shown to be associated with an increased risk of premature pre-labour rupture of membranes (PPROM) [7,9]. The mechanism behind this is hypothesised to be related to the up-regulation of inflammatory cytokines [11] and the increased risks of genital [12] and urinary tract [13] infections predisposing to chorioamnionitis in obese women.

**Post-term pregnancy**

A progressive relationship between increasing BMI and prolonged gestation was demonstrated in a retrospective study of 9336 births. Higher pre-pregnancy BMI was associated with a higher risk of pregnancy progressing past 40 weeks of gestation, with 28.5% of obese women progressing beyond 41 weeks of gestation, compared with 21.9% of normal-weight women ($P < 0.001$). Obese women also had an increased risk of reaching 42 weeks of gestation compared with women of normal pre-pregnancy BMI, with an adjusted odds ratio (OR) of 1.69 (95% confidence interval (CI), 1.23–2.31) (Fig. 1) [4].

Similar results have been found in other large population-based observational studies [14,15]. The results are significant even considering the vast number of obese women who are delivered electively, either by induction of labour (IOL) or by elective caesarean section, before they reach 40 weeks or beyond, leading to an increased need for IOL for post-dates pregnancies (Table 1) [16].

The mechanism behind the prolongation of gestation in obese women is unclear. Some authors have postulated that endocrine factors, which may have a role in the initiation of labour, are altered in obese women due to an excess of hormonally active adipose tissue [4].

![Fig. 1. Survival curves for BMI categories, with delivery as the failure event, $P < 0.001$ for log-rank test. Reprinted from Am J Obstet Gynaecol, Vol 197 edition 378, Stotland, N. E., Washington, A. E., and Caughey, A. B. Prepregnancy body mass index and the length of gestation at term. e1–378.e5 with permission from Elsevier.](image-url)
Preparation prior to labour

The antenatal care of an obese pregnant woman involves preparation of the woman, staff and family for the intrapartum and post-partum periods. Accurate documentation of weight at the booking visit is essential and a reweighing in the third trimester of morbidly obese women is important for planning for manual handling equipment. The guidelines for the management of obese women in pregnancy from the United Kingdom recommend that women with a booking BMI of \( \geq 30 \text{ kg/m}^2 \) have an informed discussion about possible intrapartum complications and their management with a consultant obstetrician, which is documented in the antenatal notes. The multidisciplinary approach involves not only good obstetric and midwifery care but also careful screening of co-morbidities such as gestational diabetes and hypertensive complications, dietary advice and review by the specialist obstetric anaesthetist to identify potential difficulties during the intrapartum period. Manual handling assessment in the third trimester using validated scoring tools are helpful for planning prior to admission to hospital. These antenatal preparations, although resource intense, ensure effective communication between staff involved in her care as well as keeping the woman well informed, minimising the chances of adverse outcomes [17].

Induction of labour

There is little data on the outcomes of IOL in the obese woman in the preterm setting. Several large studies have shown a relationship between obesity and an increased incidence of IOL [12,14,16,18–20]. IOL is required more often due to both the strong association of medical co-morbidities with obesity, such as diabetes mellitus and hypertension, and the increased rates of post-term pregnancies seen in obese women. Even when the presence of pre-eclampsia is adjusted for, compared with normal-weight women, morbidly obese women are more likely to be induced, with an adjusted OR of 2.38 (95% CI 2.17–2.60) [9].

Arrowsmith et al., in a retrospective cohort study of 29,224 women, found that higher maternal BMI at booking was associated with an increased risk of prolonged pregnancy and IOL, and 8497 women (29.1%) had their labours induced. As maternal BMI increased, so too did the increase in the number of women requiring IOL – 26.2% of normal-weight women, 30.5% of overweight women, and 34.4% of obese women. Of the women in the study, 3076 had a prolonged pregnancy (defined as \( \geq 41 + 3 \) weeks of gestation). A significantly higher rate of IOL ending in caesarean section in obese women was observed (Table 2) [16].

Similar experiences were noted in the UK, where less than half of the obese women (47%) were noted to have laboured spontaneously, one-third (33%) underwent an IOL and one-fifth (20%)
underwent a caesarean section prior to labour. The spontaneous labour and induction rate in the general maternity population at the same time were 69% and 20%, respectively [5]. Obesity is associated with higher rates of failure of induction, with 5.7% of obese women with BMI of 30.0 \text{–} 39.9 \text{ kg/m}^2 and 3.9% of women with a BMI > 40.0 \text{ kg/m}^2 requiring caesarean section for a failed IOL in one study of 1273 women induced with prostaglandin [21]. In a population-based cohort study of 80,887 women by Wolfe et al., the rate of failed IOL (as determined by delivery by caesarean section) was 29% in women with BMI > 40 kg/m^2, compared with 13% of women with a normal BMI. Factors associated with failure of induction included nulliparity, lack of a previous successful vaginal delivery and presence of macrosomia [22].

As in the non-obese parturient, IOL may be carried out by various methods, such as prostaglandin, cervical ripening balloon catheter, artificial rupture of the membranes, oxytocin infusion or a combination of these methods. IOL should only be undertaken for the usual obstetric and medical indications. Maternal obesity alone is not an indication for IOL [17].

The high rate of caesarean section and the morbidity associated with emergency caesarean section in obese women have led to the discussion regarding the consideration of elective caesarean section in morbidly obese women who do not labour spontaneously. Wolfe et al. (2014) demonstrated that the risk of caesarean delivery increased with elective labour induction at term in obese nulliparous women with an unfavourable cervix. This study supports the assertion that labour induction be medically indicated or, if performed for non-medical indications at term, the favourability of the cervix needs to be ensured [23].

The decision regarding the mode of delivery, however, should take each individual’s circumstances into consideration and include a discussion with the multidisciplinary team responsible for pregnancy care. Obesity class, cervical examination, prior obstetric history and estimated fetal weight also need to be taken into account [22]. The recent Centre for Maternal and Child Enquiries (CMACE) report on maternal obesity in the UK states that “in the absence of obstetric or medical indications, labour and vaginal delivery should be encouraged for women with obesity” [5].

### Location of intrapartum care

With the increased risks of intrapartum complications, along with the added surgical and anaesthetic complications in obese women, it is essential that delivery be conducted in a facility where senior obstetric staff and access to theatre are immediately available. A policy of planning delivery in a regional specialist or tertiary centre, rather than in small, rural maternity units, has been recommended [24], as access to appropriate care in labour and timely assessment by midwives, obstetricians and anaesthetists should lead to the prevention of delays in performing any necessary interventions and improving outcomes [5,25].

The CMACE/Royal College of Obstetricians and Gynaecologists (RCOG) Guidelines on the Management of Women with Obesity (2010) recommend that women with a BMI >35 kg/m^2 give birth in a consultant-led obstetric unit as not all facilities have the necessary equipment to enable health

### Table 2


<table>
<thead>
<tr>
<th>BMI group</th>
<th>Mode of labour onset</th>
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<tbody>
<tr>
<td></td>
<td>Spontaneous (n = 17 417)</td>
</tr>
<tr>
<td>Underweight (%) (n = 2831)</td>
<td>69.0</td>
</tr>
<tr>
<td>Normal (%) (n = 13 231)</td>
<td>64.1</td>
</tr>
<tr>
<td>Overweight (%) (n = 7 989)</td>
<td>56.9</td>
</tr>
<tr>
<td>Obese (%) (n = 3 303)</td>
<td>50.5</td>
</tr>
<tr>
<td>Very obese (%) (n = 1 267)</td>
<td>43.7</td>
</tr>
<tr>
<td>Morbidly obese (%) (n = 603)</td>
<td>35.5</td>
</tr>
<tr>
<td>Overall (%) (n = 29 224)</td>
<td>59.6</td>
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professionals to care appropriately and safely for obese women in labour [5,17]. This is supported by the National Institute for Health and Care Excellence (NICE) Clinical Guideline, which also recommends that women with a BMI between 30.0 and 34.9 kg/m² undergo an individual risk assessment regarding the planned place of delivery [26]. The CMACE report further recommended that obese women with a BMI >35 may not be suitable for entirely midwifery-based care and that these women give birth in a consultant-led setting [5]. Analysis of the worldwide prevalence of obesity indicate that rural areas and resource-poor settings carry the greatest burden [1,27] with low-income households and poor education status linked to rising trends in obesity [28]. This creates a dilemma that, whilst recommendations for centralisation of care are based on the concentration of expertise and physical resources to cater to the morbidly obese women, the social and financial upheavals associated with this need to be considered. Although relocation for intrapartum care is a significant burden on the woman, safety in pregnancy is paramount and appropriate support should be put into place to minimise this disruption from home life. If a woman is to relocate for confinement, the timing of this relocation should be guided by local capacity and arrangements. Inter-facility transfer is best conducted prior to the onset of labour, in the antenatal period. Transfer can be problematic once labour has been established due to the increased need for, and the difficulties with, monitoring both the maternal and fetal status, as well as the technical difficulties in arranging appropriate transport for the morbidly obese woman.

**Transfer of obese women for intrapartum care**

The rise of obesity in rural and regional settings means that, increasingly, medical transport teams are involved in the transfer of obese patients to tertiary-level care. This is an important consideration for countries such as Australia where transfers may involve vast distances. Currently, studies of outcomes of inter-facility transfer of obese parturients are limited. Obese pregnant women provide especially challenging logistical and manual handling issues associated with transfers. Beebe et al. [29] identified various difficulties ambulance crews face when transporting obese patients and illustrate methods used in the US to transport obese patients using modified equipment. In Australia where road transport may be especially prolonged in remote regions, air ambulance services such as the Royal Flying Doctors Service (RFDS) require referring centres to document an accurate weight for their patients. The maximum weight that an aircraft can carry depends on flying time and other necessary equipment. Above approximately 180 kg, the RFDS advises that alternate road transport may need to be organised [30]. With road transport, difficulties can be experienced even with simple care procedures such as the use of bedpans, insertion of indwelling catheters, pressure care and respiratory care [31]. The importance of early assessment and planning for early inter-facility transfer is stressed by many studies and guidelines [16,17,26,32,33].

**Resources required for obese women in the intrapartum period**

Occupational as well as patient health and safety requirements indicate that the care of obese women necessitates specialised equipment. The implementation of a ‘bariatric protocol’ to identify and mobilise the necessary equipment and resources is suggested for maternity units caring for the obese parturient [34]. Appropriate lateral transfer equipment and hoists for patient bed transfers and an operating table with appropriate safe working load are required for the safe care of such women [17]. When special beds for the morbidly obese are required, staff familiarity with these is required in case a woman needs to be laid flat urgently for resuscitation [5]. Specialised equipment in combination with a specific population group at a risk of complications necessitates further requirements for staff training. All staff involved in the care of obese women should receive manual handling training.

The Obstetric Anaesthetic Association and the Association of Anaesthetists of Great Britain and Ireland recommend that operating tables in all maternity theatres be able to support a weight of at least 160 kg with alternative provision for women who exceed this weight. It also states the maximum weight of the operating tables available must be made known to all staff involved [35]. The standard modern operating table can support a weight of 130–160 kg. Specialised tables available can support weights up to 225 kg and also up to 360 kg, which also include lithotomy stirrups. These must be available in centres caring for morbidly obese women [36]. Other equipment such as appropriately
sized thromboembolic-deterrent stockings (TEDS), large blood pressure (BP) cuffs, large wheelchairs and appropriate ward, bathroom facilities and delivery beds should be available. Patient positioning and transfer are affected by obesity [25]. The weight limitations of some equipment, such as lithotomy poles, may preclude the ready use of lithotomy in some circumstances. Suitable alternatives, such as Yellofin® Stirrups and Yellofin® Elite® Stirrups (Allen Medical Systems, Acton, MA, USA), have a patient weight capacity of 159 and 227 kg, respectively, and should be readily available for this reason. Extra staff may also be required to assist in achieving the lithotomy position, either in the labour ward or in the operating theatre, especially if a regional anaesthetic is being used. An inflatable air transfer system, such as the HoverMatt® (HoverTech International, Bethlehem, PA, USA), should be available for use prior to the placement of epidural anaesthesia in the labour ward, and in operating theatres for safe patient transfer [25].

The availability of an ultrasound machine is recognised as a good practice point in caring for obese woman in labour [17]. Due to abdominal adiposity, adequate palpation of the maternal abdomen to determine fetal presentation can be technically very difficult. Determination of the fetal presentation by the use of ultrasound can itself be difficult in cases of extreme obesity. Ultrasound may also be required to assist in the visualisation of veins in cases of difficult cannulation and is increasingly being used in the placement of epidural catheters. For regional anaesthesia, extra-long spinal and epidural needles are also necessary. Appropriately sized graduated compression stockings should be employed at a minimum. Inflatable sequential compression devices should also be considered for use intra-operatively [34]. Consideration of post-partum thromboprophylaxis regardless of the mode of delivery is essential in the obese parturient [17].

Furthermore, it has also been recommended that senior obstetric, midwifery and anaesthetic staff be available for the care of women with a BMI ≥40 during labour and delivery [17].

Intrapartum monitoring and assessment

Women with BMI >40 kg/m² should receive one-to-one midwifery care in established labour [17]. Two attendants should be present for vaginal delivery with consideration to deliver in the lithotomy position to allow adequate access should manoeuvres become necessary [37]. Senior obstetric and anaesthetic staff should be alerted and be available for the care of women with a BMI >40 kg/m² [5]. The operating theatre staff should also be alerted. Regular review by senior clinicians may help to identify any intrapartum complications as they arise, and to guide management accordingly [17]. Senior obstetric and anaesthetic staff should be present for operative deliveries, due to the increased difficulty encountered in both abdominal and vaginal deliveries in morbidly obese women [5,17].

Due to the increased risk of adverse events, including pre-eclampsia, gestational diabetes, stillbirth and the potential for undiagnosed growth restriction [38,39], it is recommended that pregnancies complicated by maternal obesity should have continuous electronic fetal monitoring (EFM) in labour [40,41]. The risk of stillbirth in the obese population is especially pronounced at term gestation, with the highest risk in the morbidly obese [39].

External monitoring may become impossible in labour due to abdominal adiposity and the pannus. There is no evidence to support the routine use of internal fetal monitoring in this population, but application of the fetal scalp electrode should be considered if a satisfactory recording is not obtained by external monitoring and where continuous electronic monitoring is required [25,42]. In the same study that reported challenges with monitoring uterine contractions, 26% of obese parturients required invasive fetal monitoring, compared with no cases in the control group (P < 0.001) [37]. On occasions where application of a fetal scalp electrode is contraindicated, that is, prematurity and maternal serology positive for blood-borne viruses, prolonged monitoring with a portable ultrasound machine may become necessary if the fetal heart rate pattern obtained is not reassuring and needs further observation [43]. With a large pannus, palpation and detection of uterine contractions may also be difficult and inaccurate. In the setting of IOL, oxytocin augmentation or vaginal delivery after caesarean section, accurate detection of contractions is vital, and the use of an intrauterine pressure transducer should be considered [37,44].

Vaginal examination and abdominal palpation in the obese woman is more challenging due to physical obstruction by adipose tissue and decreased mobility. The availability of a portable ultrasound
scanner in the labour ward will aid with the confirmation of fetal presentation. Ray et al. [37] found a higher incidence of difficult vaginal examinations in obese women due to poor access to the perineum. Accurate and timely vaginal examinations are essential in labour especially in a subgroup of women already at a risk of dysfunctional labour.

**Progress of labour and labour dystocia**

There is a greater incidence of prolonged labour in obese women [44–46]. There is evidence that uterine contractility in obese women may be altered or impaired [47,48]. Fat deposition in the maternal pelvis and fetal macrosomia may also contribute to labour dystocia [12,44,45] leading to an increased risk of caesarean delivery. There is overwhelming evidence that obesity is significantly associated with both elective and emergency caesarean section [7,12,14–16,18–21,44,45,49].

In vitro studies of human myometrium at elective caesarean section at term confirmed that the strength and rate of myometrial contraction was lower in obese women compared to women of normal weight. It was hypothesised that this decreased contractility was due to altered cholesterol levels in the obese, which detrimentally affected myometrial cells [47]. Myometrial smooth muscle contraction occurs in response to rising intracellular calcium [50]. The coordinated action of uterine contraction is orchestrated by catecholamines, which produce the progression in both the frequency and amplitude of contractions necessary in labour [50,51]. In the study reported by Zhang et al. [47], the effects of cholesterol were dose dependent and reversible with the removal of cholesterol from the in vitro environment. Moynihan et al. [48] showed that leptin concentrations were increased in obesity and their in vitro studies demonstrated that this reduction in myometrial contractility was related to the inhibitory effect of leptin. Chu et al. [52] in their study on the risk of stillbirth in the obese patient found that the prevalence of fetal macrosomia (birthweight >4 kg) was increased in obese women compared to women of normal weight. Fetal macrosomia can result in cephalo-pelvic disproportion manifesting as arrested or obstructed labour.

After adjusting for maternal height, pregnancy weight gain, labour induction, membrane rupture, oxytocin use, epidural analgesia and fetal size, the median duration of labour from 4 to 10 cm was 6.2 h for normal-weight women, 7.5 h for overweight women and 7.9 h for obese women. The slow progression that is seen in these women occurs mostly between 4 and 6 cm in overweight women, and in active labour under 7 cm in obese women. No noticeable difference was observed after cervical dilatation of 7 cm in either group. The authors concluded that the differences in labour progression seen among women with increasing BMI should be taken into account before additional interventions are performed [45]. Similar results were seen in a cohort of 509 women (71% of whom were nulliparous) undergoing IOL [44]. As maternal weight increased, the rate of cervical dilatation slowed, and the mean duration from oxytocin initiation to delivery increased. In nulliparous women, a difference of 5 h in labour duration was seen between those in the highest weight quartile and those in the lowest quartile (Fig. 2) [46]. This study, along with others, also demonstrated that, as maternal weight increased, so did oxytocin requirements and, irrespective of parity, increasing weight is associated with a decreased rate of cervical dilatation and an increased labour duration [21,46].

The prolongation of labour duration appears limited to the first stage of labour only [20,45,53]. Increasing maternal BMI was not associated with a difference in second-stage duration, regardless of whether the labour was induced or spontaneous [20]. A large population-based study also demonstrated no difference in failure to progress in the second stage of labour between obese women and non-obese women [53]. A prospective trial of 71 women did not demonstrate a difference in second-stage intruterine pressure between obese women and those with a normal BMI [54]. This study also found that, although obese women had longer labours overall and required oxytocin augmentation more often, the duration of the second stage was similar among all weight groups. These studies support the finding that the increased risk of caesarean section in obese women is mostly confined to the first stage of labour, to which labour dystocia is a major contributor [12,55].

Increasing BMI is associated with reduced rates of spontaneous vaginal delivery [56]. The chance of a spontaneous vaginal delivery in women with a BMI >35 kg/m² is 55% [5], and this rate reduces to 36.7% in morbidly obese women [8]. Data regarding instrumental delivery in the second stage are conflicting, with CMACE reporting instrumental vaginal delivery rates of 7.6% of all singleton deliveries.
in obese women, compared with 12.2% in the general maternity population [5]. The United Kingdom Obstetric Surveillance System (UKOSS) indicated a lower operative vaginal delivery rate [57], and this is thought to be due to the high rate of caesarean sections, and perhaps added to by a reluctance of practitioners to perform instrumental vaginal deliveries in obese women [5,11,42].

Prolonged labour also puts women at the risk of chorioamnionitis, operative deliveries, post-partum endometritis and wound infections [58]. This must be taken into consideration in the intra-partum as well as the post-partum period.

**Intrapartum analgesia and anaesthesia**

Due to the increased risk of intrapartum complications, obese women should be encouraged to be admitted early and have venous access established early in labour [17] as this may present a challenge and should therefore be undertaken by those with the necessary experience; multiple failed attempts can add to an already potentially difficult task [5]. It is recommended that women with a BMI >40 kg/m² be reviewed by an obstetric anaesthetist in the antenatal period, so potential problems such as venous access can be identified before the birth [5].

The preferred method of analgesia in any pregnant patient is regional anaesthesia due to the increased morbidity and mortality associated with general anaesthesia; this is more pertinent in the obese woman [31]. However, it is not without its difficulties. Obese patients are more at risk of multiple epidural attempts compared to patients of normal weight (30% vs. 0%) [37,58,59]. This difficulty is related to distortion and concealment of anatomic landmarks because of adipose tissue. Multiple attempts are also thought to explain the higher incidence of dural puncture in obese patients [60]. Failure of regional anaesthesia is also higher in the obese patient [37], and thus the necessity for a general anaesthetic in a difficult patient under emergency conditions is a high possibility.

Increased morbidity and mortality associated with general anaesthesia are mainly related to the difficulties associated with intubation. Soft tissue changes associated with pregnancy are complicated further by the physical limitations associated with obesity, that is, short neck, increased soft tissue mass, decreased motility and greater weight of breasts, which decreases lung capacity and the significant risk of aspiration pneumonitis. These difficulties indicate that, often, a second anaesthetist is required, fibre-optic techniques are utilised, the use of laryngeal mask airways become necessary and, in dire situations, cricothyrotomy is performed [58]. The extra difficulty associated with general anaesthesia with an obese patient indicates that care is time consuming and costly. Preparation with
review in the antenatal period as well as skilled staff and adequate resources will improve intrapartum care for the obese woman. Medical co-morbidities, such as diabetes mellitus and sleep apnoea, add to the perioperative risk.

**Macrosomia and shoulder dystocia**

Pre-pregnancy weight is the most important factor influencing birthweight in obese women [59]. Obese women are two to three times more likely to give birth to a large-for-gestational-age (LGA) infant (birthweight >4000 g), even after adjustment for diabetes mellitus [5,12,15,22,34,53,61–63]. Complications associated with LGA include malpresentation, operative vaginal delivery, shoulder dystocia, caesarean section, post-partum haemorrhage (PPH), perineal trauma, low Apgar scores and admission to neonatal intensive units [34,54].

Data regarding shoulder dystocia are conflicting. Population-based cohort studies have shown that shoulder dystocia was significantly increased in women with obesity, with an OR ranging from 1.61 (95% CI 1.04–2.51) to 3.0 (OR 3.14, 95% CI 1.86–5.31) [9], with obesity as an independent risk factor [63]. On the contrary, in a study of women with a BMI >50 kg/m², an increased risk was not demonstrated. The authors hypothesise that this may be due to the extremely high rate of caesarean delivery in this group [49]. In another large population-based study, after accounting for diabetes, Sheiner et al. failed to demonstrate obesity as an independent risk factor for shoulder dystocia, despite the high incidence of fetal macrosomia [53]. These findings were supported by a case–control study by Robinson et al. They demonstrated that maternal obesity is not an independent risk factor for shoulder dystocia, when the confounding effects of macrosomia, diabetes and mid-pelvic instrumental delivery are controlled for, and fetal macrosomia remained the strongest predictor [64]. The obstetric care provider should be prepared in any event to manage this obstetric emergency when it arises.

**Instrumental delivery**

Instrumental vaginal delivery can be particularly challenging in obese women due to associations with fetal macrosomia and shoulder dystocia [19,52,53], which contribute to perineal injury, perinatal morbidity and PPH [34,65]. A higher incidence of second-degree, but not third-degree, perineal tear has been seen in primiparous obese women [61]. Therefore, an attempted operative vaginal delivery in an obese woman must take these factors into consideration, and senior obstetric staff should be present to perform or supervise operative deliveries in women with a BMI >40 kg/m² [17].

**Caesarean section**

The risk of caesarean delivery is more than double for obese women compared to women with a normal BMI [12,35,52,66]. The adjusted OR for the most morbidly obese women (BMI >50 kg/m²) from UKOSS data was 3.50 (95% CI 2.72–4.51) [49]. The risk of caesarean section increases with increasing BMI, as shown in the CMACE report on maternal obesity, where the caesarean section rate was 37% among singleton pregnancies in women with a BMI >35 kg/m², and 46% in women with a BMI >50 kg/m² [5].

**Postnatal management**

Admission to the intensive care unit occurs more commonly among women with a BMI >50 kg/m² compared with women of normal weight (adjusted OR 3.86 (95% CI 1.41–10.6)) [49]. Obesity and its complications are also associated with longer hospital stays and higher costs [8,22]. Hospital admissions longer than 5 days are seen increasingly in women with a BMI >30 kg/m² (OR 1.49 (95% CI 1.21–1.86)) and >40 kg/m² (3.18 (2.19–4.61)) [56].

Obese women are at a higher risk of suffering a significant PPH [14,55]. Although the increased caesarean rate can contribute to the higher incidence of PPH, Sebire et al. [12] demonstrated that obese women were more at risk of PPH even after correcting for confounders such as mode of delivery. Active management of the third stage reduces the risk of PPH [17,67,68]. Fyfe et al. [55] found that obese
women had a twofold increase in the risk of major PPH (>1000 mls) regardless of the mode of delivery. The significance of BMI in the risk of PPH is demonstrated further by Vinayagam et al. [6] who found that women with a BMI of >40 kg/m² had nearly three times the risk of a PPH compared to women of normal weight.

Obesity is an added risk factor for venous thromboembolism, and risk assessments should be carried out throughout the antenatal, intrapartum and post-partum period and appropriate thromboprophylactic measures instituted.

**Conclusion**

Caring for obese women in pregnancy places significant demands on health-care resources. Specialised equipment and well-trained staff are required to manage the specific requirements of such women and the potentially significant complications that may arise for the mother, fetus and neonate. Good multidisciplinary care needs to be formulated and communicated to all stakeholders, including the woman herself. A policy of networked care and plans for centralisation of care for the morbidly obese woman should be considered in order to ensure safe outcomes for the mother and baby as well as cost-effective allocation of resources.

**Practice points**

- Multidisciplinary approach to planning for antenatal, intrapartum and postnatal care.
- Identification of co-morbidities and complications associated with obesity in pregnancy.
- Involvement of senior staff in all aspects of care.
- Awareness of risks associated with induction of labour and intrapartum care in the obese parturient.
- Awareness of the occupational health and safety considerations.
- Awareness of resources available and equipment specifications in the care of obese women.
- Consideration of location of intrapartum care and the challenges involved in the transfer of obese parturients.

**Research agenda**

2. Outcomes of induction of labour versus spontaneous onset of labour in the obese parturient.
3. Elective versus emergency caesarean section in the obese parturient.
4. Inter-facility transfer of obese parturients.
5. Social and psychological impact of transfer of care of the obese pregnant woman.

**Conflict of interest**

The authors have no conflict of interest to declare.

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