Comparison of maternal and perinatal outcomes in women with super obesity based on planned mode of delivery.

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Abstract

Background:

Currently, little evidence exists to guide mode of delivery in pregnant women with super obesity. There is a trend towards elective caesarean delivery in this population with little evidence of improved maternal or neonatal outcomes.

Aim:

Our study compares maternal and neonatal outcomes based on planned mode of delivery and aims to identify predictors for a successful vaginal delivery.

Materials and Methods:

This retrospective observational study explored maternal and neonatal outcomes of women with a body mass index ≥ 50 who birthed a singleton pregnancy ≥ 36 weeks gestation over a 10-year period at a single centre in Melbourne, Australia. Outcomes between women having a planned vaginal or planned caesarean birth were compared on an intention to treat basis, with logistic regression used to determine factors predictive of a vaginal birth.

Results:

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275 women with super obesity were identified. 199 (72%) planned a vaginal birth, which was successful for 70%. Planned vaginal birth was associated with lower rates of postpartum complications requiring readmission (5% vs. 16%; $p=0.003$). Neonatal resuscitation requirements and Apgar scores at five minutes were similar between groups. Multiparity was the strongest predictor of a successful vaginal birth while medical intervention in labour was associated with a reduced rate of success in primiparous women.

Conclusions:

Contrary to current trends in practice a trial of labour for women with super obesity, when facilities and skills permit, appears a safe option for mother and baby.

Introduction

The prevalence of super obesity (body mass index, BMI ≥ 50 kg/m²) in women of childbearing age is increasing in developed countries globally ⁽¹⁻³⁾. In the UK & US the prevalence is 0.1% and 1.8% respectively, while in Australia it is 2.14 per 1000 ⁽⁴⁻⁶⁾. These pregnancies are high risk, due to increased antenatal, intrapartum and postpartum complications ⁽⁷⁾. Antenatally, women with super obesity are more likely to have pre-existing medical conditions ⁽⁸⁾. Women are also more likely to develop gestational diabetes mellitus (GDM), pregnancy induced hypertension and preeclampsia ⁽⁷⁾. Fetal monitoring is difficult; ultrasound scans are less sensitive for fetal abnormalities and growth restriction ~~and women have higher rates of stillbirth~~ ⁽⁹⁾. Compared to women with a normal BMI, those with super obesity have a higher risk of stillbirth, caesarean section (CS), postpartum haemorrhage (PPH) and surgical complications ⁽¹⁰⁻¹²⁾. Obstetricians and anaesthetists are concerned about the risks of urgent surgical delivery as these women are twice as likely to have failed regional anaesthesia and six times more likely to require a general anaesthetic when compared to both women who are obese and of normal BMI ⁽¹³⁾. Obesity causes a distortion of anatomical landmarks, providing further challenges to the surgical approach and postoperative wound complication rates can be as high as 30% ^{(11), (14, 15)}. ~~These concerns have resulted in an increase in CS with one meta-analysis showing CS rates up to three times higher~~ These risks likely contribute to a two-fold higher elective CS rate among nulliparous women with obesity compared to normal BMI ⁽¹⁶⁾.

While, the risks associated with a BMI ≥ 50 kg/m² are increasingly understood, few studies are available to assist clinicians in counselling women regarding the likely
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success of a vaginal birth and the associated outcomes. To date only one study has been undertaken comparing outcomes by planned mode of delivery in 591 women with super obesity. No difference in maternal and neonatal outcomes were seen, supporting that standard obstetric indications should inform mode of delivery⁽¹⁷⁾ ~~and did not identify any difference and therefore did not support universal elective CS.~~ We sought to assess whether planned mode of delivery impacted on maternal and neonatal outcomes within our population and identify factors predictive of a successful vaginal birth to guide clinical management.

Materials and methods

This is a retrospective observational study undertaken in a single tertiary hospital in Melbourne, Australia. Between January 2005 and December 2015 all women with a recorded BMI ≥ 50 at the booking visit were identified and data was extracted from the Birthing Outcomes Summary Database. Women were included if they had a singleton pregnancy that delivered ≥ 36 weeks gestation. Maternal blood loss ≥ 500 mls for vaginal delivery and ≥ 1000 mls for CS defined a PPH. Prolonged length of stay was defined as women remaining as inpatients beyond the hospital recommended length of stay after birth, which is beyond two nights for a vaginal delivery and three nights for a caesarean birth.

Cohorts were defined as women who planned a vaginal birth or planned a CS, which was booked during their routine antenatal visits. Further sub-group analysis was also performed to compare outcomes in elective caesarean to emergency caesarean births. This study received ethics approval from Monash Health Human Research Ethics Committee (16381Q).

Statistical Analysis

Continuous variables were assessed for normality. Characteristics of the women and their babies, obstetric interventions, maternal and neonatal outcomes were compared between women who planned and women who did not plan a vaginal birth using standard techniques (χ^2 , independent t-tests or Kruskal Wallis tests). Among women who planned a vaginal birth, the crude associations between maternal and labour characteristics with achieving a vaginal birth were determined using logistic regression. Backward stepwise logistic regression was then used, including all

variables in the crude analysis with a $p < 0.1$ to determine the final multivariate model to predict a vaginal birth. The receiver operative characteristics curve was determined for the final model. A p -value < 0.05 (two-tailed) was regarded as significant. All analyses were performed using the Stata/IC 12.1 (StataCorp, College Station TX).

Results

Between 2005-2015, 275 women with super obesity delivered a singleton pregnancy after 36 weeks gestation at a Melbourne tertiary hospital. The majority of women planned a vaginal delivery ($n=199$; 72%) with 28% ($n=76$) planning a CS. ~~22/199 women had a previous CS~~ There were 22 out of 53 eligible women who planned a vaginal birth after CS of whom 9 (41%) were successful. Women planning a vaginal birth were, on average, younger, more likely to be primigravid and have pre-eclampsia (see table 1). Importantly, no difference in BMI or the rate of GDM was seen. There were 72 (37.3%) multiparous women who planned a CS for obstetric indications, such as previous CS ($n=64$, 89%), non-vertex presentation ($n=7$, 10%) and placenta praevia ($n=1$, 1%) .

Differences in the rates of obstetric intervention, maternal and neonatal outcomes are presented in Table 2. Overall 70% ($n=140$) of women in the planned vaginal delivery group achieved a vaginal birth. In the planned vaginal delivery group 54% had their labour induced and three (1.5%) women did not labour, instead undergoing a CS for undiagnosed breech/unstable lie. The emergency CS rate was 29.7% (59/199). Women in the planned CS group had a significantly higher postpartum blood loss compared to those having a planned vaginal birth (500 ml vs. 400 ml, $p=0.001$). However, PPH rates (6.6% vs. 24.6%, $p = 0.001$) were significantly lower for planned CS group, while readmission rates (15.8% vs. 5%, $p=0.003$) were significantly higher. On sub-group analysis, women who planned a vaginal birth but required an emergency CS, their PPH rate was 16.9% and readmission rate was 8.5%.

In regards to neonatal outcomes (Table 2), babies born to women planning a vaginal delivery were at an advanced gestational age (40 weeks vs. 38 weeks; $p=0.001$), however no significant difference in birthweight was observed (3846g vs. 3732g, $p=0.17$). Babies in the planned vaginal delivery group were significantly more likely to have high cord lactates (44.7% vs. 14.4%; $p<0.001$) and meconium-stained liquor (27.6% vs. 6.6%; $p<0.001$). There was no difference in resuscitation requirements. This article is protected by copyright. All rights reserved

(42.2% vs. 38.2%; $p = 0.11$), five-minute Apgar scores or increase in nursery admission rates between babies in the planned vaginal birth and planned caesarean group. The prevalence of large for gestational age (birthweight $>95^{\text{th}}$ centile) was 26.6% in the planned vaginal delivery group. This was not significantly different to the planned CS group (29%; $p=0.7$). Importantly, among those planning a vaginal birth, no significant difference in birthweight was seen between those who achieved a vaginal delivery and those who required an emergency CS ($p=0.88$).

Factors associated with a successful vaginal birth are displayed in Table 3 and 4. We identified in the crude analyses that multiparity and past vaginal birth were associated with an increased odds of achieving a vaginal birth (OR 4.64, $p<0.001$; OR 7.83, $p=0.005$). Of the 81 nulliparous women planning a vaginal birth 42 (51.8%) were successful, compared to 98/118 (83%) multiparous women. In contrast, augmentation of spontaneous labour with syntocinon (OR 0.27, $p=0.02$), labour induction (OR 0.29, $p=0.08$) or epidural use (OR 0.33, $p=0.01$) was associated with reduced odds of achieving a vaginal birth. A multivariate analysis showed each year of increasing maternal age was associated with a 9% reduced odds of successful vaginal birth (table 4). Induction of labour was associated with reduced success of a vaginal birth in primigravid women on multivariate analysis, but not multigravida women (table 4).

Discussion

This study examined planned mode of delivery and its impact on maternal and neonatal outcomes in women with super obesity. These findings are important, as research has shown that labour management in this group of women is a source of great anxiety for clinicians^(18, 19) and clinical decision-making is undertaken with little evidence to support it. Research shows that this clinician-based concern can lead to earlier medical intervention and higher CS rates without necessarily producing better outcomes for the mother or neonate⁽¹⁹⁾.

We reviewed pregnancy outcome data of women with a BMI ≥ 50 kg/m² who delivered over a 10-year period in a single tertiary referral centre. We, like others, observed higher rates of GDM in women with super obesity compared to the average population (20% vs. 13%)^(20, 21). Of women who planned a vaginal delivery 98% laboured, with an emergency CS rate of 29.7%, which is higher than the Australian national average of 16%⁽²²⁾. The main indications for an emergency caesarean were

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failure to progress (49%), fetal distress (33.8%) and non-vertex presentation (1.5%). These findings are comparable to Homer et al. where 30% of planned vaginal deliveries required an emergency CS ⁽¹⁷⁾. Elective CS was only performed for obstetric indications.

The risk of having either an elective or emergency CS has been reported to increase with increasing BMI ⁽¹⁶⁾. Antenatal factors contributing to this are increased rates of pre-eclampsia, GDM, macrosomia and an increased incidence of pre-existing medical conditions ^(7, 23, 24). Intrapartum factors include difficulty in monitoring the progress of labour, fetal well-being and maternal contractions due to maternal body habitus. Concerns about the availability of senior obstetric staff and the recognition that obesity is a significant risk factor for anaesthesia-related mortality further encourages earlier surgical intervention ^(19, 25). In our study we observed an overall CS rate of 50% and an emergency CS rate of 29.7%, which was comparable to other studies ^(6, 17, 21). Maternal blood loss was significantly higher in the planned CS group, in keeping with surgical intervention, while PPH rates were significantly lower. Of interest, significantly higher rates of hospital readmission occurred among women having a planned CS compared to a planned vaginal birth, with rates of readmission similar between elective CS and emergency CS groups. Marcela et al. reported similar findings when exploring the association between maternal obesity and intraoperative complication at CS in 51,218 women ⁽²⁶⁾. Their results showed that women with super obesity undergoing emergency CS did not have an increased risk of intraoperative complication (ARR 0.59, 95% CI 0.32 – 1.10) when compared to normal BMI women. They hypothesized that hyper-vigilance and preparedness of the medical team may contribute to lower complication rates. In our study, women who achieved a vaginal birth had higher immediate postpartum complications, but their recovery measured by length of stay was similar and readmission rate was lower than those having a CS. ~~Indicating, with careful planning and a multidisciplinary approach~~ This suggests that a planned vaginal delivery can be as safe as a planned CS.

Routinely women with super obesity receive serial third trimester ultrasound assessment of fetal growth. Ultrasound assessment has known limitations in this population due to maternal body habitus and fetal positioning late in pregnancy ⁽²⁷⁾. While important to identify the growth-restricted fetus, it is reassuring that the finding

of macrosomia did not influence the probability of a successful vaginal delivery in our study.

The impact of mode of delivery on neonatal outcomes revealed a higher incidence of meconium-stained liquor and elevated cord lactates among the planned vaginal delivery group (table 3), which is not unexpected in a labouring cohort. However, neonates in both groups had no statistical difference in resuscitation requirements, Apgar scores at five minutes and special care nursery (SCN)/ neonatal intensive care unit (NICU) admissions suggesting that beyond the initial transition-period to life outside the womb there was no short-term increased morbidity. There was also no significant difference in neonatal birthweight between the two groups. We know from research that neonates born to women with obesity are more likely to be large for gestational age, have hypoglycaemia and require NICU admission ^(4, 10). However, Homer et al, concluded that mode of delivery did not influence neonatal morbidity⁽¹⁷⁾. These findings are reassuring, since clinical concerns exist about the ability to adequately monitor the fetus in labour, particularly during the second stage ⁽¹⁸⁾. This concern may contribute to the higher rates of initial resuscitation and lower initial Apgar's observed in some studies. In our tertiary institute, however, it is routine clinical practice to use fetal scalp electrodes and intrauterine pressure catheters, when needed, to monitor fetal well-being and uterine contractions in order to facilitate appropriate clinical intervention.

We examined factors associated with a successful vaginal birth. . ~~Multiparity and previous vaginal birth were the strongest predictors of a vaginal delivery and this supports~~ After controlling for other variables, the strongest predictor of a successful vaginal delivery was having previously had one, supporting the idea that irrespective of BMI these women should be encouraged to labour. Like others, we also found primiparity was associated with an increased risk of CS,⁽²¹⁾. While, we did not find a significant association between diabetes and an increased likelihood of an emergency CS, as shown by others ⁽²¹⁾.

The impact of medical intervention in those planning a vaginal delivery was influenced by parity. Among nulliparous women, compared to spontaneous onset of labour, those requiring augmentation with syntocinon or induction of labour appeared to have a significant reduction in the odds of a successful vaginal birth on multivariate This article is protected by copyright. All rights reserved

analysis. However, confounders that necessitated such interventions may have influenced these findings. While, recent meta-analyses indicate that term induction of labour is not associated with an increased risk of CS, these findings relate to a low risk population and data from pregnancies complicated by super obesity is lacking^(28, 29). In contrast, no significant impact of augmentation or induction of labour was observed in multiparous women's chance of a successful vaginal birth. As such, induction of labour should still be strongly considered if medically indicated, with other studies, like ours, showing similar maternal and neonatal morbidity to an elective CS⁽³⁰⁾.

~~Spontaneous onset of labour and minimal medical intervention, though not statistically significant, favoured a vaginal birth in this group. Induction of labour and intrapartum intervention including augmentation of spontaneous labour with oxytocin appeared to have a detrimental effect on achieving a vaginal delivery in nulliparous women. While these findings are supported in the literature⁽²¹⁾, induction of labour should still be strongly considered if medically indicated, with other studies showing it has similar maternal and neonatal morbidity to an elective CS⁽²⁹⁾.~~

The results from this study support a vaginal birth in this complex population. A successful vaginal birth had comparable maternal morbidity with no increase in neonatal morbidity, while the risks and comorbidities associated with an emergency CS were similar to that of an elective CS. Our findings conclude that a CS should only be offered for routine obstetric indications.

The strengths of our study include a large number of planned vaginal births. An elective CS rate of almost 50% for women with super obesity has been reported⁽²¹⁾, however in our group 72% planned a vaginal delivery. The group characteristics were also similar, with the only other comparable study having significantly more women of advanced maternal age (≥ 35 years) in the planned caesarean group⁽¹⁷⁾. Lastly, these results are from a single tertiary centre, which assists in minimising the impact of different institutional practices on maternal and neonatal outcomes.

The weaknesses' to the study include its retrospective nature and relatively small sample size. This sample size is similar to the only other comparable study looking at This article is protected by copyright. All rights reserved

outcomes in these women by intended mode of delivery and while the prevalence of super obesity is rising, overall numbers still remain small in individual centres⁽¹⁷⁾.

Conclusion:

The management of women with super obesity in pregnancy is becoming an increasingly common challenge in obstetrics. There has been a lack of evidence to guide the optimal mode of birth in these women and a clear understanding of the rates of the associated risks. In this study, we have shown that vaginal birth was associated with a similar morbidity to planned CS, without increasing the risk of significant neonatal morbidity. This information provides reassurance to women aiming for a vaginal birth especially if they present in spontaneous labour. It will enable clinicians to counsel women with super obesity about expected outcomes when planning their mode of birth.

Table Legend:

Table 1: Maternal characteristics by planned mode of birth.

Table 2: Obstetric interventions, maternal and neonatal outcomes by planned mode of birth

Table 3: Crude association between potential risk factors and achieving a vaginal birth in women who planned a vaginal birth

Table 4: Multivariate model of factors that predict achieving a vaginal birth

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	Planned caesarean n= 76	Planned vaginal birth n=199	P value
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Table 1: Maternal characteristics by planned mode of birth

Maternal age (years) [†]	33 (5.6)	30 (5.7)	0.003*
Maternal BMI (kg/m ²) [†]	53.6 (3.8)	52.9 (3.1)	0.15
Parity			<0.001*
Nulliparous	4 (5.3%)	81 (40.7%)	
Indications for planned CS			
Non-vertex	2 (50%)		
Placenta praevia	1 (25%)		
Psychological health	1 (25%)		
Multiparous	69 (90.8%)	108 (54.3%)	
Grand multiparous	3 (3.95%)	10 (5%)	
Indication for planned CS			
Previous CS	64 (89%)		
Non-vertex	7 (10%)		
Placenta praevia	1 (1%)		
Australian born	64 (84.2%)	157 (78.9%)	0.32
Gestational diabetes mellitus			0.18
No GDM	58 (76.3%)	161 (80.9%)	
Diet controlled GDM	5 (6.6%)	19 (9.6%)	
Insulin dependent GDM	13 (17.1%)	19 (9.5%)	
Pre-eclampsia	1 (1.3%)	15 (7.5%)	0.049*
Current smoker	12 (16%)	32 (24.4%)	NS
Spontaneous quitter	4 (5.3%)	17 (13%)	0.047*
Baby sex-female	45 (59%)	90 (45.2%)	0.038*

Statistics are presented as Number (%) or Mean (SD, as indicated by[†]) and * = statistical significance. Where BMI = Body mass index, GDM = Gestational diabetes mellitus, NS = not significant.

Table 2: Differences in obstetric interventions, maternal and neonatal outcomes by planned mode of birth

	Planned cesarean n= 76	Planned vaginal birth n=199	P value
Maternal outcomes			
Onset of labour			<0.001*
Induced	0 (0%)	108 (54.3%)	
No labour	73 (96%)	3 (1.5%)	
Spontaneous	3 (4%)	88 (44.2%)	
Gestation (weeks)	38 (38-39)	40 (38-40)	0.001*
Vertex presentation	62 (81.6%)	193 (97%)	0.001*
Mode of birth			<0.001*
Vaginal birth	0 (0%)	115 (57.8%)	
Instrumental vaginal	0 (0%)	25 (12.6%)	
Planned CS	71 (93.4%)	0 (0%)	
Emergency CS	5 (6.6%)	59 (29.7%)	
Maternal blood loss [†]	500 (400-600)	400 (250-600)	0.001*
3 rd /4 th degree tear	0 (0%)	1 (0.5%)	
Episiotomy	0 (0%)	15 (7.5%)	
PPH	5(6.6%)	49 (24.6%)	0.001*
Emergency CS [#]		10 (16.9%)	
Transfusion needed	2 (2.6%)	5 (2.5%)	0.96
Mother readmitted	12 (15.8%)	10 (5.0%)	0.003*
Emergency CS [#]		5 (8.5%)	
LOS prolonged	38 (50%)	124 (62.3%)	0.06*
Neonatal outcomes			
Baby birthweight (grams) [†]	3732 (84.3)	3846 (39.6)	0.17
Vaginal birth		3842	0.88
Emergency CS		3855	
Large for gestational age	22 (29%)	53 (26.6%)	0.70
Meconium liquor	5 (6.6%)	55 (27.6%)	<0.001*
Apgar score @5 minutes [†]	9 (9-9)	9 (9-9)	0.13
Cord lactate			
Cord lactate ≥ 4.0 mmol/L	11 (14.4%)	89 (44.7%)	<0.001*

Missing cord lactate	25 (32.9%)	39 (19.6%)	
Resuscitation of baby			0.11
Nil	47 (61.8%)	115 (57.8%)	
Suction/Tactile only	14 (18.4%)	48 (24.1%)	
IPPR	4 (5.3%)	20 (10.1%)	
CPAP	11 (14.5%)	13 (6.5%)	
Endotracheal intubation	0 (0%)	3 (1.5%)	
SCN/NICU admission	17 (22.4%)	66 (33.2%)	0.08

Statistics are presented as Mean (SD), Number (%) or Median (Inter quartile range, as indicated by[†]) and * = statistical significance. Where PPH = post partum haemorrhage (≥ 500 mls for vaginal or ≥ 1000 mls for section) and LOS = length of stay IPPR = intermittent positive pressure respiration, CPAP = Continuous positive airway pressure, SCN = special care nursery and NICU = neonatal intensive care unit.

[#] PPH and readmission rates amongst women who required an emergency CS in the planned vaginal birth group

Table 3: Crude association between potential risk factors and achieving a vaginal birth in women who planned a vaginal birth.

	Crude Odds Ratio (95% CI)	P value
Maternal age (years)	0.95 (0.90 to 1.003)	0.06
Maternal BMI	1.05 (0.95 to 1.17)	0.32
Parity		
Nulliparous	ref	-
Multiparous	4.64 (2.40 to 9.10)	<0.001*
Grandmultiparous	3.71 (0.74 to 18.60)	0.11
Australian born	1.00	-
Non-Australian born	0.54 (0.26 to 1.10)	0.09
GDM		
No GDM	ref	1.00
Diet controlled GDM	0.53 (0.20 to 1.41)	0.21
Insulin dependant GDM	0.84 (0.30 to 2.35)	0.74
Pre-eclampsia	0.83 (0.27 to 2.54)	0.75
Gestation (weeks)	0.99 (0.80 to 1.23)	0.94
Birthweight (grams)	0.99 (0.99 to 1.00)	0.88
Baby gender-male	0.84 (0.46 to 1.57)	0.60
Labour Parameters		
Spontaneous labour	1	-
Spontaneous labour + amniotomy	1.17 (0.22 to 6.12)	0.85
Spontaneous labour + syntocinon	0.27 (0.08 to 0.84)	0.02*
Induced labour without cervical ripening	0.55 (0.23 to 1.30)	0.17
Induced labour + cervical ripening	0.29 (0.11 to 0.72)	0.008*
Epidural	0.33 (0.14 to 0.77)	0.01*
Past vaginal birth [†]	7.83 (1.90 to 32.50)	0.005*

Where BMI = Body mass index, GDM = Gestational diabetes mellitus, [†] = parous women only and * = statistically significant.

Table 4: Multivariate model of factors that predict achieving a vaginal birth

Nulliparous women	Adjusted Odds Ratio (95% CI)	P-value
Maternal age (years)	0.91 (0.84 to 0.99)	0.045*
Labour Parameters		-
Spontaneous labour	1.00	-
Spontaneous labour + amniotomy	ND	-
Spontaneous labour + syntocinon	0.13 (0.02 to 0.93)	0.04*
Induced labour without cervical ripening	0.16 (0.03 to 0.91)	0.04*
Induced labour with cervical ripening	0.19 (0.03 to 1.08)	0.06
Parous women		
Maternal age (years)	0.90 (0.08 to 1.01)	0.08
Labour Parameters		
Spontaneous labour	1.00	-
Spontaneous labour + amniotomy	1.46 (0.20 to 10.70)	0.71
Spontaneous labour + syntocinon	0.97 (0.09 to 10.50)	0.98
Induced labour without cervical ripening	9.45 (0.99 to 89.40)	0.05*
Induced labour with cervical ripening	1.12 (0.17 to 7.15)	0.91
Epidural	0.10 (0.11 to 0.86)	0.03*

Past vaginal birth	11.30 (1.86 to 67.80)	0.008*
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* = Statistical significance

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