

Incidence and risk factors for surgical wound complications in women with body mass index >30 kg/m² following cesarean delivery: a secondary analysis



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BACKGROUND: Surgical wound complications are common and occur in between 3% and 12% of obese women after cesarean delivery. An understanding of the risk factors for wound complications may inform potential areas for clinical care improvement.

OBJECTIVE: This study aimed to identify the incidence and predictors of surgical wound complications in obese women after cesarean delivery.

STUDY DESIGN: This was a secondary analysis of the ADding negative pRESSure to improve heaLLING, or DRESSING, randomized controlled trial conducted at 4 maternity hospitals in Australia. A total of 2035 women with a prepregnancy body mass index ≥ 30 kg/m² undergoing cesarean delivery were included. Data were collected between October 2015 and December 2019 using self-reporting of signs and symptoms, the research nurses' direct observation of the surgical site, and medical records. Independent blinded outcome assessors ascertained wound outcomes on the basis of self-reported data and medical records. Multivariable logistic regression models were used to identify independent risk factors for wound complications and surgical wound dehiscence. The 30-day cumulative incidence of wound complications and surgical wound dehiscence was calculated.

RESULTS: Of the 2035 women, 317 (15.6%) developed a wound complication, whereas 211 (10.4%) developed surgical wound dehiscence. The predictors of a wound complication included 1 previous cesarean delivery (odds ratio, 1.41; 95% confidence interval, 1.05–1.90; $P=.02$) and ruptured membranes >12 hours (odds ratio, 1.69; 95% confidence interval, 1.08–2.66; $P=.02$). The odds of developing any wound complication decreased by 45% with vaginal cleansing (odds ratio, 0.55; 95% confidence interval, 0.42–0.72; $P<.001$) and by 59% for low transverse incision (odds ratio, 0.41; 95% confidence interval, 0.18–0.94; $P=.04$). The predictors of surgical wound dehiscence included 1 previous cesarean delivery (odds ratio, 1.62; 95% confidence interval, 1.14–2.31; $P=.008$) and ruptured membranes >12 hours (odds ratio, 1.85; 95% confidence interval, 1.10–3.12; $P=.02$). The odds of developing surgical wound dehiscence decreased by 50% for vaginal cleansing (odds ratio, 0.50; 95% confidence interval, 0.36–0.69; $P<.001$) and by 42% for using a double-layer uterine closure (odds ratio, 0.58; 95% confidence interval, 0.35–0.97; $P=.04$).

CONCLUSION: Wound complications and surgical wound dehiscence in this population are high. The predictors observed herein would assist in identifying high-risk women. Such information may guide patient-centered decision-making in the planning of surgical births and individualized postoperative care.

Key words: cesarean delivery, cumulative incidence, obesity, predictor, wound breakdown, wound disruption, wound infection, wound separation

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The authors report no conflict of interest.

This work received funding from the National Health and Medical Research Council project grant APP1081026 (\$2,285,351).

Ethics approval: Ethical approval was obtained from The Royal Brisbane and Women's Hospital Human Research Ethics Committee HREC/15/QRBWH DRESSING trial (approved on June 21, 2015).

Cite this article as: Gillespie B, Ellwood D, Thalib L, et al. Incidence and risk factors for surgical wound complications in women with body mass index >30 kg/m² following cesarean delivery: a secondary analysis. *Am J Obstet Gynecol Glob Rep* 2022;2:100069.

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2666-5778/\$36.00

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<http://dx.doi.org/10.1016/j.xagr.2022.100069>

AJOG Global Reports at a Glance

Why was this study conducted?

The risk factors for dehiscence and wound complications following cesarean delivery are a significant cause of morbidity.

Key findings

Several predictors such as the use of preoperative vaginal cleansing with antiseptic solution before cesarean delivery and double closure of the uterus reduce the development of wound complications and surgical wound dehiscence after surgery.

What does this add to what is known?

The results of this study identified several important predictors in reducing wound dehiscence and surgical wound complications and may assist obstetricians in the planning of individualized postoperative care

Introduction

The rates of cesarean delivery (CD) continue to climb globally, and it is now one of the most common operations performed worldwide. In countries within the Organization for Economic Cooperation and Development (OECD), CDs represent 15% to 32% of all births.¹ Within the OECD, Australia is ranked eighth highest worldwide, whereas United States is ranked 10th for this mode of birth. Although CD is generally safe for both the woman and her infant, wound complications following CD are not uncommon (3%–15%)² and can be associated with significant morbidity. A significant postoperative wound complication is surgical wound dehiscence (SWD), defined as the separation or splitting of the margins of a closed surgical incision in the skin with or without the exposure or protrusion of underlying tissue, organs, or implants.³ SWD occurs in 3% to 4% of women postoperatively^{4,5} and is often associated with surgical site infection (SSI) and/or wound collection.⁶

The risk factors for wound complications following CD include premature rupture of membranes, preeclampsia, raised maternal body mass index (BMI), length of incision, use of corticosteroids, and subcutaneous tissue thickness.^{4,6,7} However, many earlier studies are limited by inadequate sample size and/or their retrospective nature,^{8,9} overreliance on routine surveillance data⁴, or incomplete or

suboptimal follow-up^{7,10} and are thus constrained to accurately ascertain the prevalence of this important surgical complication. In addition, many previous studies of factors predisposing patients to SWD have either focused on just SSI^{10,11} or have defined SWD as a composite of “wound complications”^{6,12,13} rather than as a discrete entity. Furthermore, even fewer studies have prospectively investigated the incidence of and predictors for SWD.

The aim of this secondary analysis of a recent large randomized controlled trial (RCT)¹⁴ was to identify the incidence and predictors of wound complications and SWD in obese women following CD.

Materials and Methods

We performed a secondary analysis of data from the ADding negative pRESure to improve healing (DRESSING) RCT (registered with the Australian and New Zealand Clinical Trial Registry: ACTRN12615000286549).¹⁴ This multicenter parallel-group RCT evaluated negative pressure wound therapy against standard surgical dressing in obese women (BMI ≥ 30 kg/m²) undergoing CD at 4 large public metropolitan maternity hospitals in Queensland, Australia between October 2015 and December 2019. The primary outcome in the DRESSING RCT was SSI using the Centers for Disease Control and Prevention (CDC) definition.¹⁵ Ethics and governance approvals were obtained from the Royal Brisbane and

Women’s Hospital (reference number HREC/15/QRBWH).

Women were excluded if they had any evidence of preoperative infection (eg, chorioamnionitis), had previously participated in the trial, or were unable to speak or understand English. Written informed consent was obtained from all women.

All women received standard peri- and postoperative care according to Australian clinical practice guidelines.^{16,17} All CDs were performed by 2 medical practitioners (either specialist obstetricians or obstetrical trainees). Before skin incision, the abdomen was cleansed with alcoholic or aqueous chlorhexidine or povidone iodine. Most skin incisions were transverse suprapubic incisions. Owing to the pragmatic nature of the parent trial, the technique of skin closure (either suture or staples) was at the discretion of the operating obstetrician. The choice of standard hospital dressing (transparent vs hydrocolloid) was based on the obstetrician’s preference. Surgical dressings were applied according to the manufacturers’ recommendations after skin closure in the operating room. Across all hospital sites, the dressings were left intact for 5 to 7 days, which is the time period recommended by the dressing manufacturer. The choice of cleansing solutions used for vaginal preparation was based on the obstetrician’s preference.

The primary outcome was wound complication, defined as a composite variable combining any of the following: SWD, SSI, hematoma, seroma, or bleeding on the basis of previous literature.^{3,7,12,18–20} Owing to the lack of clarity in the definition of SWD in the literature, SSI and SWD were defined on the basis of the CDC criteria.¹⁵

Data were collected from the research nurses’ (RN) direct observation of the surgical site and/or medical records. Demographic and clinical information (eg, age, prepregnancy BMI, hypertension, diabetes, parity, previous CD, gestational diabetes mellitus, intact vs ruptured membranes, American Society of Anaesthesiologists [ASA] score, etc) was collected. The BMIs were recoded

into Obesity Class 1 (BMI, 30.0–34.9), Class II (BMI, 35.0–39.9), and Class III (BMI \geq 40).²¹ All data were entered directly into a regularly audited research data capture database (REDCap; Vanderbilt University, Nashville, TN).

Assessment of wound complications and surgical wound dehiscence

A RN reviewed women on postoperative day 2 in hospital to examine the surgical site and document any evidence of SSI if dressing change occurred. If visual assessment was not possible, information was obtained from women's clinical notes or the nurse who changed the dressing. After discharge, the same RN contacted the women weekly for 4 weeks and asked them a series of questions focused on signs and symptoms relevant to SWD, SSI, hematoma, seroma, and bleeding. Subsequently, 2 experienced RNs blinded to group allocation independently determined the likelihood of any wound complication on the basis of the recorded data. A third blinded assessor adjudicated and made the final decision where there were discrepancies.

Data analysis

Statistical analyses were performed using SPSS (version 25; IBM Corp, Armonk, NY). Descriptive statistics using means, standard deviations (SD) or medians, and interquartile range (IQR) were used for continuous variables depending on the distribution of data. Categorical variables were summarized using absolute and relative frequencies. These summary measures were used for comparative sample characteristics on the basis of wound complications and SWD status. Potential obstetrical and surgical risk factors of wound complications included in the analyses were informed by previous research^{3,7,18,19} and included the following: age, BMI, hypertension, diabetes, anemia in the third trimester, respiratory disorders, number of previous CD, ASA status, ruptured vs intact membranes, prophylactic antibiotics, preoperative vaginal cleansing, type of skin incision, method of placental delivery (controlled cord traction or manual

removal), single- vs double-layer uterine closure, subcutaneous fat closure, wound drain, skin closure method, duration of operation, and group allocation in the parent trial (intervention or control arm).

Chi-square and Fisher exact tests were used as appropriate to examine differences between women who developed wound complications and those who did not. Chi-square tests were used to assess the differences in the numbers of women with any wound complication (ie, SWD, SSI, hematoma, seroma, or bleeding) and SWD vs those without wound complications and use of analgesia for incisional pain. Two separate multivariable logistic regression models were used to examine the association between obstetrical and surgical factors and outcomes, any wound complication (composite outcome), and SWD. We wanted to identify the factors independently correlated with wound complications and SWD in this patient cohort. We followed the guidance by Sperandei²² and used a *P* value of $<.20$ to indicate statistical significance at the univariate level. Thus, predictors with a *P* $<.20$ were entered into the 2 final multivariable models. All the significance tests were 2-tailed, and the crude and adjusted odds ratios (OR), 95% confidence intervals (CI), and *P* values $<.05$ are reported.

Patient and public involvement

The patients and the public were not directly involved throughout the research process (including formulation of research questions, outcome measures development, study design, recruitment, and dissemination of the results). At the time the parent study was conceived, patient and public involvement of consumers was not widely adopted in Australia.

Results

A total of 2035 women with a prepregnancy BMI of ≥ 30 kg/m² gave birth by planned and semiurgent CD in the parent RCT, and of these, 16 ($<1\%$) withdrew their consent after randomization, and 12 ($<1\%$) were lost to follow-up. The outcomes (wound complications

and SWD) are based on 2035 women using an intention-to-treat population from the parent trial. The average age of women across the entire sample was 31.1 years (SD, 5.5 years; range, 16–54 years). The primary outcome occurred in 317 of the 2035 (15.6%) women, whereas 211 of the 2035 (10.4%) women were diagnosed with the secondary outcome, ie, SWD. The incidence of individual complications across the sample were as follows: seroma (53/2035; 2.6%), bleeding (30/2035; 1.5%), and hematoma (17/2035; 0.8%). The clinical characteristics and proportions of the women in each group (ie, those that did vs those that did not develop any wound complications and SWD) across each outcome are displayed in [Table 1](#).

Univariate analyses of relationships between obstetrical and surgical characteristics and the primary composite outcome indicated that BMI Class III (BMI ≥ 40 kg/m²), hypertension, respiratory disease, number of previous CDs, intact vs ruptured membranes, use of vaginal cleansing, use of lower transverse incision, controlled cord traction, method of uterine closure, and wound drain were statistically significant at *P* $<.20$. These variables were then included in a multivariable logistic regression model. The results of the adjusted analysis indicated that only 1 previous CD (OR, 1.41; 95% CI, 1.05–1.90; *P*=.02) or ruptured membranes >12 hours (OR, 1.69; 95% CI, 1.08–2.66; *P*=.02) were independently associated with the development of any wound complication ([Table 2](#)). The odds of developing any wound complication decreased by 45% for preoperative vaginal cleansing (OR, 0.55; 95% CI, 0.42–0.72; *P* $<.001$) and by 59% for low transverse skin incision (OR, 0.41; 95% CI, 0.18–0.94; *P*=.04).

Univariate analyses of relationships between demographic and obstetrical characteristics and SWD indicated that Class III obesity, hypertension, number of previous CDs, intact vs ruptured membranes, use of preoperative vaginal cleansing, single- vs double-layer uterine closure, and wound drain were statistically significant at *P* $<.20$. These variables were then included in a

TABLE 1
Characteristics of the sample (n=2035)

Obstetrical and surgical characteristic	No wound complications n=1718; 84.4%	Wound complications n=317; 15.6%	Crude OR (95% CI)	No SWD n=1824; 89.6%	SWD present n = 211; 10.4%	Crude OR (95% CI)
Age (y) ^a Mean (standard deviation)	31 (5.4)	31 (5.7)	1.00 (0.98–1.02)	31 (5.5)	31 (5.7)	1.00 (0.97–1.02)
^a Duration of operation (min) median (interquartile range)	61 (25.0)	62 (25.0)	1.00 (1.00–1.07)	61 (26.0)	62 (24.0)	1.00 (1.00–1.01)
Duration of operation ≤60 min	788 (45.9)	136 (43.2)	0.89 (0.70–1.14)	878 (48.2)	96 (45.9)	0.94 (0.70–1.25)
Duration of operation >60 min	927 (54.1)	179 (56.8)	Ref	943 (51.8)	113 (54.1)	Ref
Types of surgery						
Planned	1239 (72.1)	233 (73.5)	Ref	1318 (72.3)	154 (73)	Ref
Urgent	479 (27.9)	84 (26.5)	0.93 (0.71–1.22)	506 (27.7)	57 (27.0)	0.96 (0.70–1.33)
Body mass index kg/m ²						
Class I: 30.0–34.9	864 (50.)	148 (46.7)	Ref	916 (50.2)	96 (45.5)	Ref
Class II: 35.0–39.9	441 (25.7)	74 (23.3)	0.98 (0.72–1.33)	461 (25.3)	54 (25.6)	1.12 (0.79–1.59)
Class III: ≥40.0	413 (24.0)	95 (30.0)	1.34 (1.01–1.78) ^b	447 (24.5)	61 (28.9)	1.30 (0.93–1.83) ^b
Comorbidities						
Diabetes mellitus	66 (3.8)	11 (3.5)	0.90 (0.47–1.72)	70 (3.8)	7 (3.3)	0.86 (0.39–1.90)
Gestational diabetes mellitus	484 (28.2)	96 (30.3)	1.11 (0.85–1.44)	521 (28.6)	59 (28.0)	0.97 (0.71–1.33)
Hypertension	217 (12.6)	52 (16.4)	1.36 (0.98–1.89) ^b	235 (12.9)	34 (16.1)	1.30 (0.88–1.92) ^b
Anemia ^c	149 (8.7)	33 (10.4)	1.22 (0.82–1.82)	162 (8.9)	20 (9.5)	1.07 (0.66–1.75)
Respiratory disease	215 (12.5)	51 (16.1)	1.34 (0.96–1.87) ^b	234 (12.8)	32 (15.2)	1.22 (0.81–1.81)
Previous cesarean delivery						
0	694 (40.4)	108 (34.1)	Ref	735 (40.3)	67 (31.8)	Ref
1	632 (36.8)	130 (41.0)	1.32 (1.00–1.74) ^b	671 (36.8)	91 (43.1)	1.49 (1.07–2.07) ^b
2	283 (16.5)	59 (18.6)	1.34 (0.95–1.89) ^b	305 (16.7)	37 (17.5)	1.33 (0.87–2.03) ^b
≥3	109 (6.3)	20 (6.3)	1.18 (0.70–1.98)	113 (6.2)	16 (7.6)	1.55 (0.87–2.78) ^b
Status of membranes ^a						
Intact membranes	1454 (84.7)	275 (86.8)	Ref	1545 (84.8)	184 (87.2)	Ref
Ruptured (≤12 h)	145 (8.4)	12 (3.8)	0.44 (0.24–0.80) ^b	151 (8.3)	6 (2.8)	0.33 (0.15–0.77) ^b
Ruptured (>12 h)	118 (6.9)	30 (9.5)	1.34 (0.88–2.05) ^b	127 (7)	21 (10)	1.39 (0.85–2.26) ^b
ASA status						
ASA 1	119 (6.9)	22 (6.9)	Ref	124 (6.8)	17 (8.1)	Ref
ASA 2	1103 (64.2)	202 (63.7)	0.99 (0.61–1.60)	1174 (64.4)	131 (62.1)	0.81 (0.48–1.39)
ASA ≥3	496 (28.9)	93 (29.3)	1.01 (0.61–1.69)	526 (28.9)	63 (29.9)	0.87 (0.49–1.55)
Prophylactic antibiotics ^d						
Preincision	1657 (97.2)	303 (97.4)	Ref	1759 (97.2)	201 (97.6)	Ref
Postincision	47 (2.8)	8 (2.6)	0.93 (0.44–1.99)	50 (2.8)	5 (2.4)	0.88 (0.35–2.22)
Preoperative vaginal cleansing	718 (41.8)	89 (28.1)	0.54 (0.42–0.71) ^b	753 (41.3)	54 (25.6)	0.49 (0.35–0.68) ^b
Low transverse incision	1699 (98.9)	307 (96.8)	0.34 (0.16–0.75) ^b	1801 (98.7)	205 (97.2)	0.44 (0.18–1.08) ^b
Controlled cord traction ^a	1522 (88.6)	270 (85.4)	0.76 (0.54–1.07) ^b	1612 (88.4)	180 (85.7)	0.79 (0.52–1.19)
Manual removal of placenta	220 (12.8)	47 (14.8)	1.19 (0.84–1.67)	239 (13.1)	28 (13.3)	1.02 (0.67–1.55)

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(continued)

TABLE 1
Characteristics of the sample (n=2035) (continued)

Obstetrical and surgical characteristic	No wound complications n=1718; 84.4%	Wound complications n=317; 15.6%	Crude OR (95% CI)	No SWD n=1824; 89.6%	SWD present n = 211; 10.4%	Crude OR (95% CI)
Double-layers uterine closure	1631 (95.0)	286 (90.2)	0.49 (0.32–0.76) ^b	1728 (94.7)	189 (89.6)	0.48 (0.29–0.78) ^b
Subcutaneous (fat) closure	1642 (95.6)	300 (94.6)	0.82 (0.48–1.40)	1741 (95.4)	201 (95.3)	0.96 (0.49–1.88)
Wound drain	95 (5.5)	11 (3.5)	0.61 (0.33–1.16) ^b	100 (5.5)	6 (2.8)	0.51 (0.22–1.17) ^b
Type of skin closure						
Subcuticular suture	1679 (97.7)	311 (98.1)	Ref	1783 (97.8)	207 (98.1)	Ref
Interrupted suture	15 (0.9)	1 (0.3)	0.36 (0.48–2.74)	15 (0.8)	1 (0.5)	0.57 (0.08–4.37)
Staples	23 (1.3)	4 (1.3)	0.94 (0.32–2.73)	25 (1.4)	2 (0.9)	0.69 (0.16–2.93)
Wound glue	1 (0.1)	1 (0.1)	5.40 (0.34–86.54)	1 (0.1)	1 (0.5)	8.68 (0.54–139.30)
Dressing received						
Standard dressing	849 (49.4)	166 (52.4)	Ref	909 (49.8)	106 (50.2)	Ref
NPWT	869 (50.6)	151 (47.6)	0.89 (0.70–1.13)	915 (50.2)	105 (49.8)	0.98 (0.74–1.31)

ASA, American Society of Anesthesiologists; CI, confidence interval; IQR, interquartile range; NPWT, negative pressure wound therapy; OR, odds ratio; Ref, reference interval; SD, standard deviation; SWD, surgical wound dehiscence.

^a Missing data for ≤ 5 women; ^b $P < .20$ were entered in the final model; ^c Anemia (Hb < 110 g/L) in third trimester; ^d 20 patients did not receive prophylactic antibiotics. Gillespie. Wound dehiscence in obese women undergoing cesarean delivery. *Am J Obstet Gynecol Glob Rep* 2022.

multivariable logistic regression model. The results of the adjusted analysis showed that only 1 previous CD (OR, 1.62; 95% CI, 1.14–2.31; $P=.008$) or ruptured membranes >12 hours (OR, 1.85; 95% CI, 1.10–3.12; $P=.02$) were independently associated with the development of SWD (Table 3). The odds of developing SWD decreased by 50% for preoperative vaginal cleansing (OR, 0.50; 95% CI, 0.36–0.69; $P<.001$) and by 42% for double-layer uterine closure (OR, 0.58; 95% CI, 0.35–0.97; $P=.04$).

Discussion

Principal findings

Several studies have examined the risk factors for post-CD SSI including superficial, deep, and organ space infections.^{23–25} However, few studies have focused on all types of wound complications (ie, infections, hematoma, seroma, and SWD) following CD, and even fewer studies have focused exclusively on SWD. We found that the overall incidence of any wound complication following CD was 15.6%. Our findings are comparable to other studies in similar populations reporting wound complication rates of 3% to 18%.^{6,7,20}

However, in our study, SWD developed in 1 in 10 women, which is somewhat higher than the 2.3% incidence (35/1522) reported by Carbonnel et al⁶ in their recent study. Our results also demonstrate that the common independent predictors for any wound complication or for SWD were 1 previous CD or ruptured membranes >12 hours. The use of preoperative vaginal cleansing and double-layer uterine closure were protective factors against developing both wound complications and SWD.

Results

The association between the number of CDs, ruptured membranes >12 hours, and wound complications has been noted in previous studies before.^{6,25,26} The length of time for which membranes are ruptured may be responsible for subclinical ascending bacterial colonization that causes contamination at the incision site.⁶ Nonetheless, it is worth noting that some of these studies included nonobese women.

There was a statistically significant decrease of 59% in the odds of developing any wound complication when a low transverse suprapubic incision was used. Yet the choice of incision in obese

women is somewhat contentious. Some experts advocate using high transverse skin incisions, because they negate the need to incise through the pannus while still maintaining a high tensile strength at the incision site.²⁷ The use of vertical incisions is less common. The results of 2 recently published systematic reviews and meta-analyses of retrospective cohort studies suggest that vertical incisions are associated with higher rates of wound complications and postoperative pain in obese women undergoing CD.^{28,29} Notably, there is a lack of high-quality evidence to guide obstetricians in the selection of the most appropriate incision to use in this patient cohort.

Although less than half of our study participants (41.8%) had preoperative vaginal cleansing, our results suggest a 45% decrease in the odds of developing wound complications including SSI when preoperative vaginal cleansing is used. Our results are similar to the results of Haas et al²⁸ 2020 Cochrane review. Haas et al's²⁸ meta-analysis of 18 trials with 6385 women found that the risk of postoperative wound infection is likely reduced by preoperative vaginal cleansing (risk ratio, 0.62; 95% CI, 0.50–0.77).²⁸ Preoperative vaginal

TABLE 2
Independent predictors of wound complications (n=2035)

Characteristic	Multivariable adjusted odds ratio (95% confidence interval)	P value
Body mass index (kg/m²)		
Class I: 30.0–34.9	Ref	
Class II: 35.0–39.9	1.04 (0.76–1.41)	.82
Class III: ≥40.0	1.30 (0.97–1.74)	.08
Comorbidities		
Hypertension	1.27 (0.90–1.80)	.17
Respiratory	1.28 (0.91–1.80)	.16
Previous cesarean delivery		
0	Ref	
1	1.41 (1.05–1.90)	.02
2	1.38 (0.96–2.00)	.08
≥3	1.20 (0.70–2.07)	.51
Status of membranes^a		
Intact membranes	Ref	
Ruptured (≤12 h)	0.54 (0.29–1.01)	.05
Ruptured (>12 h)	1.69 (1.08–2.66)	.02
Preoperative vaginal cleansing	0.55 (0.42–0.72)	<.001
Low transverse incision	0.41 (0.18–0.94)	.04
Controlled cord traction ^a	0.78 (0.55–1.12)	.18
Double-layers uterine closure	0.64 (0.40–1.00)	.05
Wound drain	0.56 (0.29–1.08)	.09

Model likelihood $\chi^2 = 62.05$, df 14, $P < .005$; Nagelkerke $R^2 = 5.2\%$; percentage correctly classified = 84.5%.

Ref, reference interval.

^a Missing data for ≤5 women.

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Strengths and limitations

Our study has several strengths. First, the data were derived from a large multisite prospective study with few exclusion criteria. Second, both women undergoing planned and semiurgent CD were included, thus increasing the generalizability of the results. Yet, we recognize some limitations. First, in conceiving the parent study, we used the CDC criteria¹⁵ to define and characterize SWD, as there was a lack of international consensus around the definition and grading of SWD. However, in 2017, sometime after our study began, an international group of surgical care experts developed a diagnostic grading system specifically for SWD,³ enabling consistent classification and reporting of this wound complication. Second, we included SWD of all grades but were unable to determine the severity of the SWD, as this was reported weekly by the women in relation to “separation of sides of the wound” (yes/no). Third, we used a composite measure for the outcome, which may make interpretation of the results, including their clinical relevance, challenging. Fourth, in the parent RCT, women undergoing emergency CD were excluded because of ethical concerns in relation to obtaining a valid consent. This may have impacted our results. However, the evidence supporting emergency CD as a risk factor for wound complications and SWD is equivocal. Although some studies have found positive associations between CDs performed as emergency procedures and increased risk of wound complications,³⁷ the results of other studies suggest that urgency of procedure is not a predictor of wound complications.³⁸ Fourth, women were followed up using weekly telephone interviews after discharge. This approach may be considered inferior than visual assessment of patients’ wounds. However, this decision was pragmatic, as bringing women in weekly would have increased the burden of participation and likely resulted in substantial loss to follow-up. We used a previously validated survey tool³⁹ to assess surgical wound infection and complications. The survey included

cleansing is now recommended before CD. However, there is little research to support the independent association between preoperative vaginal cleansing and SWD.

Double-layer uterine closure was found in 94% of the women in our study, which may have protected them against wound complications. Multivariable results suggest a decrease of 42% in the odds of developing SWD when double-layer uterine closure is used. This result is inconsistent with the results of a large RCT³⁰ and 2 large meta-analyses^{31–33} that suggest no difference in wound morbidity with the use of double-layer vs single-layer closure.³⁴ Some experts advocate

that double closure of the uterus leads to improvements in hemostasis and wound healing. Yet, others argue that double-layer suturing uses more suture material, which could cause greater tissue disruption.³⁵ Most studies in this area have examined the effect of single- vs double-layer sutures on longer term uterine scar defects and uterine rupture with subsequent pregnancy.^{30,32,36} Thus, it is difficult to draw conclusions about the short-term benefits of single- vs double-layer sutures, because studies specifically comparing these 2 closure methods are lacking.³² Moreover, no evidence-based uniform guidelines on uterine closure currently exist.³⁵

TABLE 3
Independent predictors of dehiscence (n=2035)

Characteristic	Multivariable adjusted odds ratio (95% confidence interval)	P value
Body mass index (kg/m ²)		
Class I: 30.0–34.9	Ref	
Class II: 35.0–39.9	1.20 (0.84–1.71)	.32
Class III: ≥40.0	1.31 (0.92–1.86)	.13
Comorbidities		
Hypertension	1.25(0.83–1.88)	.28
Previous cesarean delivery		
0	Ref	
1	1.62 (1.14–2.31)	.008
2	1.41 (0.90–2.21)	.13
≥3	1.65 (0.90–3.02)	.11
Status of membranes ^a		
Intact membranes	Ref	
Ruptured (≤12 h)	0.42 (0.18–0.99)	.05
Ruptured (>12 h)	1.85(1.10–3.12)	.02
Preoperative vaginal cleansing	0.50 (0.36–0.69)	<.001
Low transverse incision	0.53 (0.20–1.39)	.19
Double-layers uterine closure	0.58 (0.35–0.97)	.04
Wound drain	0.48(0.20–1.12)	.09

Model likelihood $\chi^2=52.91$, df 12, $P<.005$; Nagelkerke $R^2=5.3\%$; percentage correctly classified=89.6%.

Ref, reference interval.

^a Missing data for ≤5 women.

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a series of questions on wound infections, including the presence of redness and pain or tenderness at the incision. To ensure quality and consistency in data collection, the RNs used an interview script. Finally, our choice of predictor variables for the outcomes of wound complications and SWD was based on literature and expert opinion. Nevertheless, the final multivariable models suggested a modest 5% variance in each outcome, indicating that other factors not included might also contribute to these outcomes.

Conclusions

These results suggest that the incidence of wound complications including SWD following CD in obese women is

high, and several predictors found in this study may help to identify high-risk women in this population. These risk factors include having at least 1 previous CD and having ruptured membranes for >12 hours. The use of preoperative vaginal cleansing with antiseptic solution before CD and double closure of the uterus likely reduce the development of wound complications and SWD after surgery. Such interventions are simple, well-tolerated, and can easily be incorporated into clinical practice. ■

ACKNOWLEDGMENTS

We thank Joan Webster, BA, Nicky Cullum, PhD, and Jennifer Whitty, PhD, for their contributions as chief investigators of the parent trial.

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