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ORIGINAL ARTICLE

Effect of subcutaneous tissue closure technique in cesarean section on postoperative wound complications in obese Egyptian women

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ABSTRACT

Subcutaneous tissue closure technique is a wide area of interest for obstetricians who perform cesarean section especially on obese women while many observers studied in an extensive manner postoperative pain and wound cosmetic results.

Aim of the work: The main goal of our work was to display the differences in wound outcome results as regard postoperative wound complications comparing the two widely implemented techniques in subcutaneous tissue closure (interrupted versus continuous methods).

Results: A comparative analysis between continuous and interrupted techniques regarding wound complications (gapping, seroma, erythema, and infection) showing statistical significant differences in all four wound complications presented with p values = .019, .011, .015, and .001, in consecutive order with odds ratio in wound gapping = 5.239, wound seroma OR = 9.429, wound erythema OR = 3.709, and wound infection OR = 6.136.

Conclusions: Subcutaneous wound closure using interrupted technique of suturing in obese patients is superior to continuous technique as regard wound complications.

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Subcutaneous; seroma; wound gapping; wound infection; erythema

Introduction

Only a small number of research studies evaluated the impact of various subcutaneous tissue and skin closure methods at cesarean section (CS) [1,2]. In a meta-analysis, a major decline in incision site rupture was revealed when suturing the subcutaneous tissue in women with a subcutaneous depth >2 cm [3,4]. However, the outcome of these, the research performed, are made on a small number of patients, insufficient follow-up period of time for accurate long-term assessment [5,6].

Postoperative wound complications are one of the great issues in CS with an incidence ranging from 3% to 30% [1]. Obesity, operative time, diabetes, age of the patient, anemia, associated infection (e.g. chorioamnionitis), delayed labor with many vaginal examinations, and reduced nutrition are recognized risk factors for wound infections [7,8]. With the seek to avoid wound infection, many research studies were performed and assessed the influence of subcutaneous tissue closure in the past 20 years [9,10]. The apparent advantage of closing the subcutaneous layer is the decline in wound tension applied on tissues and the obliteration of dead space in which serous fluid and blood may collect resulting in infection and disruption [11,12]. From another aspect, there are many theoretical drawbacks that include prolonged operative time, reduced tissue mobility, and the presence of foreign material in the wound acting as a focus for infection [13].

A racial difference in the relations between BMI and body fat distribution [14,15] and body fat percentage [16] and risk of disease [9,17] were observed, Therefore, there are physiologic variations for racial differences in cesarean complications among morbidly obese women.

Esthetic results after closure of the subcutaneous layer of fat is of great importance to be considered. Development of hypertrophic scarring is thought to be

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caused by many different factors, tension acting on a scar has been concluded to be a widespread factor to initiate the pathological process [18,19]. Closure of dead spaces, closure of the subcutaneous tissue layer is believed to reduce tension on the above skin layer. Sutures closing the subcutaneous tissue layer could, therefore, lead to superior esthetic result by lessening strain on the sutures of the skin layer. Interestingly, to mention, suturing of the subcutaneous fat greatly decreases the incidence of postoperative hematoma formation and seroma development and could avoid retraction of the scar below the level of the neighboring skin, by sealing of dead space and performing best possible leveling of the opposing wound edges. In another aspect, suture closure of subcutaneous tissue at pathological level result in an inflammatory response against the suture material resulting in poor cosmoses [6,10].

Evidence-based studies conclude and support the fact that suture closure of the subcutaneous fat layer during the CS decreases the risk of wound infection and disruption in women with a subcutaneous tissue deeper than 2 cm [6,10,19], the effect of this intervention on esthetic outcome is not adequately explored in research studies [6,10,19].

Patients and methods

This is a prospective randomized study that was conducted in at multicenters in Algazeerah Hospital, Al Hussein Hospital and Kasralainy Hospital in Egypt. Four hundred pregnant women were recruited for this study who accepted to share in the present study in the period from June 2017 to December 2017 to compare continuous versus interrupted suturing of the subcutaneous layer in CS using Vicryl 3-0 in obese Egyptian women.

Consent

All pregnant women who accepted to participate in this study signed an informed consent after complete explanation of the procedure to the participant woman.

Ten surgeons performed the whole procedure of CS including the closure of subcutaneous and skin layer, all these surgeons were the consultants and specialists in Kasralainy Hospital, Alhussein Hospital and Algazeerah Hospital. No residents were responsible for performing the procedure, the residents only were assistants in the surgery. The surgeons had a standard operative procedure according to nice guidelines with a Pfannenstiel skin incision which was made to all patients in this study. Diathermy was not used in the skin cutting to decrease rate of infection, meticulous hemostasis was made in all abdominal wall layers, suction drainage was used if there is any oozing tissues to drain all layers. Patients were randomly distributed to the 10 surgeons.

The age of patients included in this research was between 25 and 35 years, with BMI $>$ 30 (so, we do not have a group of women with BMI below 30 as our focus in the present research was to assess the obese women), ladies who are candidate to perform first CS and have no medical disorders with pregnancy e.g. DM, HTN. All patients were subjected to full history taking and examination.

The following patients were excluded women with BMI $<$ 30, who made previous CS, or have any medical disorders with pregnancy as DM, HTN with pregnancy.

The number of sutures was counted using a double-check method by a team of members composed of a resident and a nurse in the operating room and counting sutures in the continuous technique was based on counting each loop as one suture when it passes from edge to edge through the subcutaneous tissue, so we aimed at unification of the statistical terms in suturing by using a term of number of sutures in both the interrupted and continuous groups (as we considered loop as suture when it passes from edge to edge). Calculation of depth of subcutaneous tissue was estimated by a special device used (a sterilized operative ruler).

Blood loss was estimated, operative time was recorded; all patients had preoperative antibiotic prophylaxis within 30 min of incision time.

Continuous or interrupted method was chosen according to the randomization of patients. Randomization of cases was done to the 400 pregnant women who were consented to participate in the study and were distributed in two groups: group A and group B. The randomization allocation was 1:1. The two groups were randomly selected, 200 in each group. Two cases from the continuous group and one case from the interrupted group did not come for the follow up after CS and they were living far away from the hospital and continued their follow up in another near by hospital to their homes so we excluded them from the results. The net of the continuous group was 198 and that of the interrupted group was 199 ladies and this is illustrated in Figure 1.

Care of the incision in the hospital was performed by keeping the wound dry and covering it with a sterilized dressing (steripad). Preoperative prophylactic dose of intravenous cephalosporins (before giving the anesthesia) and two postoperative doses of IV

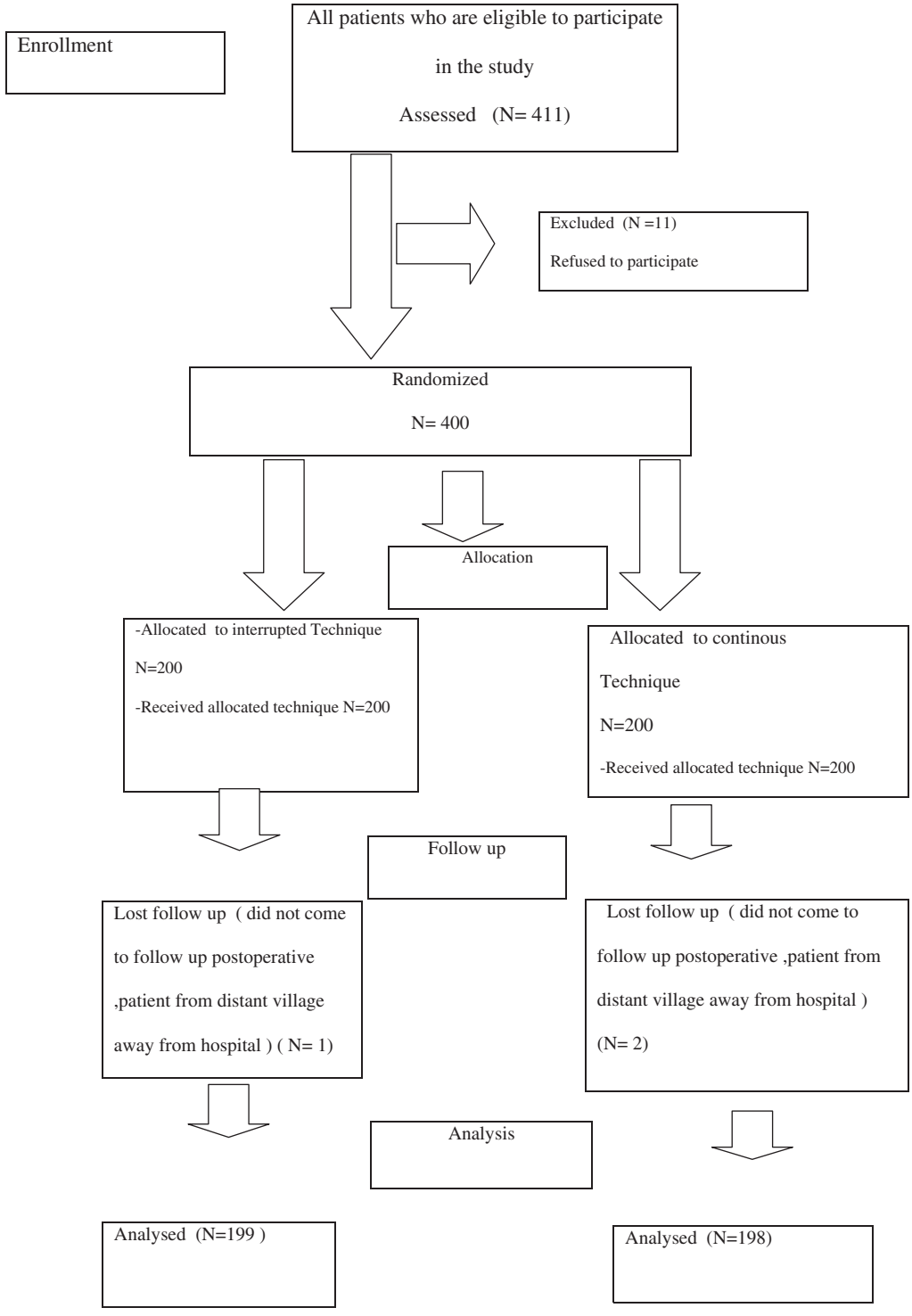

Figure 1. Consort flow diagram.

cephalosporins were given to each woman after sensitivity skin test. Patients were discharged from hospital 48 h postoperatively.

All patients were requested about the care of the wound after discharge from the hospital by keeping it dry for 1 week and, after prophylactic oral antibiotic intake, patients were instructed to come to hospital when there is any warning sign as wound redness or hardening of the surrounding area, yellowish, or green discharge, unusual increasing pain, excessive bleeding, if there is a change in the incision size or fever, then asked to come to hospital for inspection of the wound 1 week postoperative and then to visit the hospital 10 d postoperatively for stitches removal.

The time interval from the wound closure till diagnosis of the wound complications (erythema, seroma,

wound infection, and wound gapping) in most of the patients was 7 d (at first visit postoperative); however, one of the ladies came to hospital when she noticed redness of wound 5 d postoperatively and another lady came complaining of discharge from the wound diagnosed to have wound infection 6 d postoperatively.

Aim of the research

The main goal of our work was to display the difference in wound outcome results as regard postoperative wound complications comparing the two widely implemented techniques in subcutaneous tissue closure (interrupted versus continuous methods).

Results

Description

Table 1 describes and displays the following variables: type of suturing: wound complications in both study groups wound gapping, seroma, erythema, infection. Continuous and interrupted groups are nearly similar in the number of study subjects involved, wound gapping occurred in 12% of cases, wound seroma occurred in 10% of cases, wound erythema occurred in 18% of cases, and wound infection occurred in 20% of cases in the whole cohort of cases.

Table 2 displays and demonstrates the following study variables: age, BMI, GA at time of CS, number of sutures in subcutaneous tissue operative time, estimated blood loss, and subcutaneous tissue depth. The mean age of the whole cohort studied = 30.3 ± 3.3 years, mean BMI = 34.5, mean gestational age at time of CS 37.7 ± 1.1 weeks, mean number of sutures of subcutaneous tissue = 6.3 ± 2.9, operative time (min) mean = 42.8 ± 10.4 min, estimated blood loss (cc) mean = 658.8 ± 165.2 cc, subcutaneous tissue depth (cm) mean = 4.4 ± 1.0 cm.

Table 3 compares the following variables: between continuous and interrupted sutures including age, BMI, GA at the time of CS, number of sutures in subcutaneous tissue operative time (min), estimated blood loss (cc), subcutaneous tissue depth (cm), and showing statistical significant difference only regarding operative time with *p* value = <.001.

Table 4 displays and contrasts comparative analysis between continuous and interrupted regarding wound complications (gapping, seroma, erythema, and infection) showing statistical significant differences in all four wound complications presented with *p* values = .019, .011, .015, and .001, in consecutive order with odds ratio in wound gapping = 5.239, wound seroma OR = 9.429, wound erythema OR = 3.709, and wound infection OR = 6.136.

Table 5 represents univariant analysis as regard wound complications and statistical significant difference was observed as regard BMI *p* value = <.001, number of sutures with *p* value = .005, estimated

Table 1. Descriptive analysis of wound complications in relation to suture technique.

Variables	Description (*n* = 397) after exclusion of 3 cases
Suture Type	
Continuous	198 (49.9) after lost follow up of 2 women
Interrupted	199 (50.1) after lost follow up of 2 women
Wound Gapping	
Yes	12 (3)
No	385 (97)
Wound seroma	
Yes	10 (2.5)
No	387 (97.5)
Wound erythema	
Yes	18 (4.5)
No	379 (95.5)
Wound infection	
Yes	20 (5)
No	377 (95)
Wound complications	
Yes	42 (10.6)
No	355 (89.4)

Table 2. Demonestrates analysis of the demographic data and operative parameters.

Variables	Range	Mean ± SD	Median
Age (years)	25.0–35.0	30.3 ± 3.3	30.0
BMI	23.0–45.0	34.5 ± 3.6	34.0
Gestational age at time of CS	35.0–39.7	37.7 ± 1.1	38.0
No. of sutures subcutaneous	3.0–13.0	6.3 ± 2.9	5.0
Operative time (min)	30.0–60.0	42.8 ± 10.4	40.0
Estimated blood loss (cc)	350.0–1000.0	658.8 ± 165.2	650.0
Subcutaneous tissue depth (cm)	2.0–6.5	4.4 ± 1.0	4.5

Table 3. Shows a comparison between continuous and interrupted techniques as regard operative parameters and demographic data.

	Suture type		
	Continuous	Interrupted	*p* value
Age (years)	30.2 ± 3.2	30.4 ± 3.4	.444
BMI	34.8 ± 3.9	34.2 ± 3.3	.101
Gestational age at time of CS	37.6 ± 1.1	37.8 ± 1	.114
No. of subcutaneous sutures	6.3 ± 3	6.3 ± 2.8	.791
Operative time (min)	40.1 ± 9.2	45.5 ± 10.8	<.001
Estimated blood loss (cc)	644.4 ± 164.2	673.1 ± 165.4	.084
Subcutaneous tissue depth (cm)	4.5 ± 1	4.4 ± 0.9	.127

Table 4. Display a comparison between between continuous and interrupted techniques regarding wound complications.

	Suture type				
	Continuous (*n* = 198)	Interrupted (*n* = 199)	*p* value	OR	95% CI of OR
Wound gapping	10 (5.1)	2 (1)	.019	5.239	1.133–24.227
Wound seroma	9 (4.5)	1 (0.5)	.011	9.429	1.183–75.138
Wound erythema	14 (7.1)	4 (2)	.015	3.709	1.199–11.475
Wound Infection	17 (8.6)	3 (1.5)	.001	6.136	1.769–21.287

OR: odds ratio; CI: confidence interval.

Table 5. Shows univariate determinants of wound complications.

	Wound complications		
	Yes ($n=42$)	No ($n=355$)	p value
Age (years)	29.9 ± 3.5	30.3 ± 3.2	.336
BMI	37.8 ± 3.9	34.1 ± 3.4	<.001
Gestational age at time of CS	38 ± 1	37.7 ± 1.1	.077
No. of sutures subcutaneous	5.1 ± 2.4	6.4 ± 2.9	.005
Operative time (min)	44.8 ± 9.9	42.5 ± 10.4	.141
Estimated blood loss (cc)	754.8 ± 179	647.5 ± 160	<.001
Subcutaneous tissue depth (cm)	5 ± 1	4.4 ± 1	<.001
Suture type			
Continuous	33 (78.6)	165 (46.5)	<.001
Interrupted	9 (21.4)	190 (53.5)	

Table 6. Multivariate analysis (logistic regression model) to explore predictors of wound complications.

	OR	95% CI for OR	p value
Age (years)	1.005	0.887–1.138	.943
BMI	1.333	1.188–1.494	<.001
Gestational age at time of CS	1.359	0.896–2.062	.149
No. of sutures subcutaneous	1.020	0.805–1.293	.870
Operative time (min)	1.037	0.987–1.089	.146
Estimated blood loss (cc)	1.008	1.005–1.010	<.001
Subcutaneous tissue depth (cm)	1.855	1.171–2.940	.009
Continuous VS Interrupted Sutures	7.743	3.030–19.788	<.001

blood loss (cc) < 0.001, subcutaneous tissue depth (cm) p value = <.001, and continuous suture type p value = <.001.

Table 6 displays and reveals multivariate analysis to explore predictors of wound complications showing BMI of statistical significance with p value = <.001, OR = 1.333, estimated blood loss (cc) of statistical significance with p value = <.001, subcutaneous tissue depth (cm) of statistical significance with p value = .009, OR = 1.855, continuous versus interrupted sutures of statistical significance with p value = <.001, OR = 7.743.

Discussion

The results of the present study displayed the following after interpretation and analysis of data in the whole cohort of cases studied: the percentage of wound gapping occurred in 12% of cases, wound seroma occurred in 10% of cases, and wound erythema occurred in 18% of cases, while wound infection occurred in 20% of cases. The mean age of the whole cohort studied was 30.3 ± 3.3 years, mean BMI = 34.5, mean gestational age at the time of CS was 37.7 ± 1.1 weeks, mean number of sutures of subcutaneous tissue = 6.3 ± 2.9, operative time (min) mean was 42.8 ± 10.4 min, estimated blood loss (cc) mean equals 658.8 ± 165.2 cc, and subcutaneous tissue depth (cm) mean = 4.4 ± 1.0 cm. Statistical significant difference between continuous and interrupted groups as regard operative time showed statistical significant difference with a p value = <.001. That reflects reduced operative time in the continuous group of patients in which the mean time in the continuous group = 40.1 ± 9.2 min and the interrupted group = 45.5 ± 10.8 min. But as regard wound gapping, statistically significant difference has been observed with the number in the continuous group = 10 cases (5.1%), number in the interrupted group = two cases (1%), p value = .019; in addition, wound seroma showed statistically significant difference in the number of the continuous group with a mean = 9 cases (4.5%), mean of the interrupted group = 1 case (0.5%), p value = .011; wound erythema displayed also statistically significant difference in the number of the continuous group = 14 cases (7.1%); number in the interrupted group = 4 cases (2%), p value = .015; lastly the number of cases that had wound infection in the continuous group = 17 cases (8.6%) and number in the interrupted group = 3 cases (1.5%), p value = .001.

Univariant analysis as regard wound complications displayed statistically significant difference that had been observed regarding BMI with a p value = <.001, number of sutures with p value = .005, estimated blood loss (cc) < 0.001, subcutaneous tissue depth (cm) p value = < .001, continuous suture type p value = < .001.

Similarly, other authors made a research in which they categorized the study subjects into two groups (subcutaneous tissue closure group versus non-closure of subcutaneous tissue), in addition they compared between skin closure with staples or intra-cutaneous sutures, the researchers compared the following variables similar to our study in some items such as operative time and wound complications, and other items were added that were not performed in our study such as postoperative pain; in addition, they observed and evaluated long-term cosmetic out come and it was evaluated 1 year postoperatively using the Patient and Observer Scar Assessment Scale (POSAS) and Numeric Rating Scale (NRS). Similar to the number of cases recruited in our study, they recruited a total of 218 women, in which they observed the following findings: no statistical significant difference as regard long-term cosmetic results between the study research categories closure techniques investigated, except for closure time, there were no observed differences in other secondary outcome measures. They concluded the following at CS performance: suturing the subcutaneous tissue or not and using staples or intracutaneous sutures results in a similar long-term cosmetic appearance of the resultant scar [9].

Another research performed to investigate obese patients wound. Surgical drainage was conducted as

follows: an electronic exploration was applied on research; articles comparing subcutaneous tissue prophylactic drainage with no drainage performed were recognized and categorized by level of evidence. If adequate randomized controlled research trials were involved, a meta-analysis was conducted applying the random-effects model. Fifty-two randomized controlled research trials were integrated in a meta-analysis, and sub-categories were defined by particular surgical approaches including CS and other surgical procedures. Research studies were put in comparison as regard the following out comes and variables for the following wound complications: hematoma formation, wound healing morbidities, seroma, abscess, and infection. A total of 6930 operations were investigated by the research group as appropriate for this statistical research analysis. There were 3495 operations in the drain category and 3435 in the no-drain group. Prophylactic subcutaneous drainage displayed a statistically significant privilege only for (1) avoidance of hematoma formation in breast biopsy surgical procedures and (2) prevention and avoidance of seromas in axillary node surgical dissections. However, in all other procedures observed and investigated including CS in obese patients, drainage did not show any acquired advantage, denoting that CS operations can be conducted with great security without applying prophylactic surgical drainage. Therefore, the meta-analysis implied that obstetricians believed omitting drainage after CS performance, Interestingly, in addition, surgeons are not obligated to place surgical drains prophylactically in obese cases. On the other hand, surgical drain placement after a surgical procedure performed is the surgeon's option and can be based on various factors [20].

Another research randomized controlled trial of 101 women was conducted. Cases were randomly recruited to subcuticular suturing or staples. Operative mode and approach and postoperative analgesia were homogeneous. Stratification was performed for primary versus repeat cesarean deliveries. The difference in this research is that postoperative pain was the main variable to be investigated Analog pain and satisfaction scales ranging from 0 to 10 were completed at postoperative days 1 and 3, and at 6 weeks postoperatively. A digital photographic copy of the surgical incision was taken at 6-week postoperative time and assessed by three independent blinded research observers. The research group concluded the following that pain at 6 weeks postoperatively was statistically significantly less in the staple category (0.17 versus 0.51; $p = .04$). Operative time was significantly shorter in that category (24.6 versus 32.9 min; $p < .0001$). No statistical differences were observed concerning incision cosmetic appearance and women's satisfaction. They concluded from their research performed that staples are the methodology of choice for skin closure for elective term cesareans in their investigated cohort [21].

Similarly, another group of researchers conducted a study evaluating and assessing the impact of some particular gestational and other factors correlated with in adequate wound healing process in cases delivered by CS. Their study design was as an observational, prospective research study at the University Hospital of Messina with a recruitment of 212 women at term giving birth by elective cesarean delivery. The methodology conducted was implemented by collecting data concerning demographic and gestational parameters were at hospital admission, and subcutaneous tissue depth was measured intra-operatively from fascia to the surface of skin, while the length of surgical incision was measured after skin closure. The following outcomes were measured and observed including wound morbidities for example infection, seroma collection, hematoma formation, abscess, or wound dehiscence >1 cm. The results obtained and displayed by their research group were body mass index (BMI) at term [odd ratio (OR) 1.2, 95%CI 1.03–1.38; $p = .01$], wound length (OR 1.03, 95%CI 1.01–1.05; $p < .001$), and corticosteroid administration (OR 3.4, 95%CI 1.5–7.9; $p = .004$) were revealed to be linked with various wound complications observed. The receiver operating characteristics curve analysis uncovered a cut-off value of 31.1 for the BMI at term and 166 mm for the wound length with an OR of 2.28 (95%CI 1.18–4.39; $p = .013$) and 4.3 (95%CI 2.2–8.6; $p < .001$), consecutively. The multivariate logistic regression model, conducted and implemented on these observed variables and to administration of corticosteroid, presented an independent statistical interrelation and association (at term BMI > 31.1: OR 2.04, 1.01–4.13, $p = .047$; surgical wound length >166 mm: OR 4.89, 2.36–10.14, $p < .001$; administration of corticosteroids: OR 3.11, 1.38–6.95, $p = .006$). They concluded that in order to prevent postoperative wound complications surgeons performing the procedure should be cautious in steroid administration before implementation of surgery, as regard length of skin incision that should be made as small as possibly achievable and in cautiously monitoring and clinically observing pregnancy BMI [22].

In the present study, multivariate analysis to explore predictors of wound complications showed that BMI has a statistical significance with p value $= <.001$, OR $= 1.333$, estimated blood loss (cc) has a statistical significance with p value $= <.001$, subcutaneous tissue

depth (cm) has a statistical significance with p value = .009, OR = 1.855, continuous versus interrupted sutures has a statistical significance with p value = < .001, OR = 7.743.

So in the present study, the previously mentioned results denote that all wound complications are significantly less when interrupted mode of suturing is applied although operative time is significantly observed to be much prolonged in interrupted group, additionally BMI could be used as a predictor tool for wound complications. Estimated blood loss by the surgeon was a prominent parameter for the prediction of wound complications. In our research, subcutaneous tissue depth and suturing technique are even tools that can be implemented in predictability of wound complications. In the future, all variables that revealed value in predictability of wound complications could be adjusted in broader studies to be clinically used to predict and manage wound morbidities helping to calculate the risk of wound complications leading to better management of obese patients surgically particularly preoperative preparation, intra-operative management technique of closure, and postoperative care providing a guidance in effectively managing these cases by using a special formula integrating these predictors.

Conclusions

Subcutaneous tissue closure in our study groups revealed that subcutaneous wound closure using interrupted technique of suturing in obese patients is superior to continuous technique as regard wound complications; however, operative time is more. Future research should include more variables that could play a role such as ethnic differences, and operator performance variability, postoperative wound pain, and cosmetic results with a more wide cohort of patients.

The variables used in the present study could be implemented in the future to calculate the risk of wound infection in obese pregnant women performing a CS. This will result in applying better management protocols for obese cases with a special preoperative preparation, intra-operative closure technique, and postoperative care.

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Disclosure statement

All authors declare that there are no any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work.

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