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ORIGINAL ARTICLE

The Correlation Between Intra-abdominal Adhesions and Body Mass Index in Women Undergoing Elective Repeated Cesarean Section

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Abstract

Background: **Intraabdominal adhesion formation is serious postsurgery problem that occurs frequently after cesarean section. Obesity is associated with many hemostasis disturbances, particularly impaired fibrinolysis, which may increase the incidence of intraabdominal adhesions.**

Aim: **The goal of the work was to correlate between intraabdominal adhesions and body mass index (BMI) in women scheduled for a repeated cesarean section (CS).**

Patients and methods: **This was observational cross-sectional research that was carried out at Obstetrics and Gynecology Department, Faculty of Medicine, Al-Azhar University Hospitals during the period between October 2021 and April 2022, and total of 232 pregnant women undergoing repeated CS, were enrolled in our study. They were separated into two categories according to the BMI: category I: BMI less than 30 kg/m^2 ($N = 30$) and category II: BMI greater than or equal to 30 kg/m^2 ($N = 202$); group IIa ($N = 96$): BMI 30−34.9 kg/m^2; group IIb ($N = 81$): BMI thirty five − 39.9 kg/m^2, and group IIc ($N = 25$): BMI greater than or equal to 40 kg/m^2.**

Results: **No statistically significant variation was discovered among categories regarding preoperative Hgb. However, group II was associated with more significant blood loss compared with group I. Furthermore, the incidence of intra-operative visceral injuries was greater in category II compared with category I.**

Conclusion: **For women undergoing CS, there was a significant association between BMI and formation of intra-abdominal adhesion with no effect on scar thickness, more frequent depressed scar and dense adhesions, larger adhesion size, longer operation duration, and no effect on intraoperative bleeding.**

Keywords: Body mass index, Cesarean sections, Intraabdominal adhesions

1. Introduction

Worldwide, number of cesarean deliveries is increasing. Approximately 90% of women who have had previous cesarean delivery (CD) have planned repeat cesarean delivery in their subsequent pregnancy. Intraabdominal adhesions are common throughout repeat cesarean delivery and increase in prevalence and severity with numerous cesarean deliveries. Adhesiolysis can cause prolonged foetal extraction, visceral injury, and blood loss.[1]

Birth of live or dead foetus across incisions in abdominal wall (laparotomy) and uterine wall is referred to as CD (hysterotomy). CD is now one of most common procedures.[2]

Postoperative peritoneal adhesions have serious implications for studied cases, surgeons, and health-care system. Adhesions that form in abdomen after abdominal or pelvic surgery are normal response to peritoneal surface injury during surgery, and while they have some beneficial impacts, they cause significant morbidity, such as adhesive small bowel obstruction, female

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infertility, chronic abdominal pain, and difficulty with subsequent surgery.[3]

Prevention of postoperative adhesions following intraabdominal surgery is critical public health issue. Recognizing pathophysiology of adhesion formation and identifying risk factors may allow us to halt adhesiogenesis cascade. Individual factors like reproductive hormone levels, genetic variations, lifestyle, and nutritional factors are known to influence adhesiogenesis cascade.[4]

The aim of the work is to correlate between intraabdominal adhesions and BMI in women scheduled for a repeated cesarean section (CS).

2. Patients and methods

This was observational cross-sectional research that took place between October 2021 and April 2022 at Obstetrics and Gynecology Department, Faculty of Medicine, Al-Azhar University Hospitals.

The study was included 232 pregnant women candidate for repeated CS. They was separated into two categories according to the BMI to compare the degree of intraabdominal adhesions between females with BMI less than 30 kg/m^2 (group 1 = 30 cases) and those with BMI more than or equal to 30 kg/m^2 (group 2 = 202 cases).

We also subdivided group 2 candidates into three groups: group 2a (96 cases): women with BMI among 30–35. Group 2b (81 cases): women with BMI among 35–40. Group 2c (25 cases): women with BMI more than 40.

2.1. Inclusion criteria

Women over 37 weeks of gestation, pregnancy of singleton living fetus, repeated CSs and informed written consent was taken from each woman.

2.2. Exclusion criteria

Emergency CD, history of appendicitis - in particular, appendix rupture, history of gynecological infections, history of abdominal infections eg: peritonitis, and history of any medical disease as diabetes mellitus.

2.3. Study outcomes

(1) The primary study outcome was to assess adhesions between uterus and bladder, among uterus and abdominal fascia, among uterus and omentum, among omentum and abdominal fascia, and adhesions to other pelvic organs in women with BMI more than or equal to 30 kg/m^2 in comparison to females with BMI less than 30 kg/m^2.

(2) Secondary outcome parameters (other outcomes were assessed): hemoglobin drop (calculated as the difference between preoperative and postoperative hemoglobin levels) and visceral injuries.

Methodology: studied cases involved in research was subjected to:

Informed consent: was acquired to all of the participants in research.

Full History taking included: name, years old, number of cesarean sections, obstetric history, and documentation of first day of last menstrual period and gestational years old.

Clinical Examination: height and weight measurements to calculate BMI (calculated by dividing weight in kg by height in m^2), recognition of foetal heart sounds, fundal level, obstetric palpation (Maneuvers of Leopold), fundal grip to identify part of foetus occupying fundus, umbilical grip to identify back and foetal limbs, and first pelvic grip to identify engagement.

Laboratory Investigations: CBC: preoperative to detect anemia for proper preparation of the patient and postoperative detection of any hemoglobin drop.

Ultrasound: preoperative routine obstetric ultrasound examination was performed to all women scheduled for repeat caesarean delivery to confirm fetal viability, gestational age, fetal presentation, site of placenta and amount of liquor.

Ethical considerations: Study protocol was submitted for approval by Ethical Committee of Faculty of Medicine. Informed verbal and written consent was acquired from each participant sharing in research after explanation of the purpose and procedures of the study. Confidentiality and personal privacy was respected in all levels of the study.

The statistical paragraph in material and methods: When appropriate, data were statistically defined in terms of mean, standard deviation Data were be statistically described in terms of mean When appropriate, data were statistically defined in terms of mean, SD Data were be statistically described in terms of mean SD, median, and range, or frequencies (number of cases) and percentages. Kolmogorov Smirnov examination was used to examine numerical data for normal assumption. When comparing non-normal numerical data, Kruskal Wallis test was used χ^2 examination was used to compare categorical data.

3. Results

Total of 232 pregnant females undergoing repeated CS, were enrolled in our study. They were separated into 2 categories according to the BMI: Category I: BMI less than 30 kg/m^2 ($N = 30$). Category II: BMI greater than or equal to 30 kg/m^2 ($N = 202$): group Ilia ($N = 96$): BMI 30–34.9 kg/m^2. Group IIb ($N = 81$): BMI 35–39.9 kg/m^2. Group IIc ($N = 25$): BMI greater than or equal to 40 kg/m^2

Table 1 demonstrates the basic demographic data of enrolled pregnancies, including maternal age, maternal BMI, gravidity, parity, gestational years old, and interval among cesarean deliveries.

Table 2 summarizes the characteristics of pelviabdominal adhesions detected intraoperatively in each group, including overall incidence of adhesions, incidence of dense adhesions, localization, and Nair's classification of adhesions.

As shown in Fig. 1, grade 1 or 2 adhesion were found in 20% of group I, 32% of group IIa, 34% of group IIb, and 32% of group IIc. Grade 3 or 4 adhesions were found in 6.6% of group I, 9% of group IIa, 11% of group IIb, and 11% of group IIc. No statistically significant variation was showed among groups regarding Nair's classification (χ^2 test, $P > 0.05$).

As found in Table 3, no statistically significant variation was shown among categories regarding preoperative Hgb (Independent sample t test, $P = 0.968$). However, group II was associated with more significant blood loss compared with group I (Independent sample t test, $P = 0.001$). Furthermore, the incidence of intraoperative visceral injuries was greater in category II compared with category I (χ^2 test, $P = 0.002$).

Table 1. Demographic characteristics (N = 232).

	Group I ($N = 30$)	Group II ($N = 202$)	P value[a]
Years old	29.5 ± 5.2	30.1 ± 6.2	0.063
Range	25–40	24–38	
BMI (kg/m^2)	25.2 ± 3.4	36.5 ± 2.4	0.001
Range	18–29	30–45	
Gravidity	2.7 ± 0.6	2.6 ± 0.4	0.647
Range	1–4	1–4	
Parity	1.2 ± 0.3	1.3 ± 0.2	0.732
Range	0–3	0–3	
Gestational Age (weeks)	38.6 ± 4.7	38.2 ± 5.1	0.871
Range	37–40	37–39	
Interval between Cesarean Deliveries (years)	4.6 ± 1.2	4.5 ± 1.5	0.952
Range	2–6	3–5	

Data are presented as mean ± standard deviation.
[a] Independent sample t test.

Table 2. Adhesion characteristics (N = 232).

	Group I ($N = 30$)	Group II ($N = 202$)	P value[a]
Adhesions	8 (26.7)	88 (43.6)	0.002
Dense Adhesions	6 (20.0)	46 (22.8)	0.165
Localization			
Omentum	5 (16.7)	68 (33.7)	0.063
Bowel	2 (6.7)	14 (6.9)	0.074
Uterus	1 (3.3)	6 (3.0)	0.683
Nair's Classification			0.531
Grade 0	22 (73.3)	114 (56.4)	
Grade 1	4 (13.3)	55 (27.2)	
Grade 2	two (6.7)	12 (5.9)	
Grade 3	1 (3.3)	11 (5.4)	
Grade 4	one (3.3)	10 (5.0)	

Data are presented as frequency (percentage).
[a] Chi-square test, χ^2.

4. Discussion

Adhesions are fibrous bands of scar tissue that form among abdominal organs and tissues, and they can cause variety of postoperative problems, including intestinal obstruction, chronic pelvic pain, dyspareunia, infertility, and visceral injury during subsequent CSs.[5]

This was observational cross-sectional research; conducted at Obstetrics and Gynecology department, faculty of medicine, Al-Azhar university hospitals throughout duration between October 2021 and April 2022, and total of 232 pregnant women undergoing repeated CS, were enrolled in our study. They were separated into 2 categories according to the BMI: category I: BMI less than 30 kg/m^2 ($N = 30$) and category II: BMI greater than equal to30 kg/m^2 ($N = 202$); group IIa ($N = 96$): BMI 30–34.9 kg/m^2; group IIb ($N = 81$): BMI 35–39.9 kg/m^2, and group IIc ($N = 25$): BMI greater than equal to 40 kg/m^2

Analysis of our findings revealed that years old in category I was 29.5 ± 5.2 years, ranging from 25 to 40 years. Years old in category II was 30.1 ± 6.2 years, ranging from 24 to 38 years. No statistically important variation was shown between groups regarding age distribution. No statistically important variation was shown among groups regarding gravidity and parity. Mean GA in group I was 38.6 ± 4.7 weeks, ranging from thirty seven to forty weeks. Mean GA in group II was 38.2 ± 5.1 weeks, ranging from thirty seven to 39 weeks. Mean interval was 4.6 ± 1.2 years (range, 2–6) in group I, and 4.5 ± 1.5 years (range, 3–5) in category II. No statistically important variation was shown among categories regarding the interval between cesarean deliveries.

In agreement with our results, research of Fouad *and colleagues*,[6] revealed that there was no important

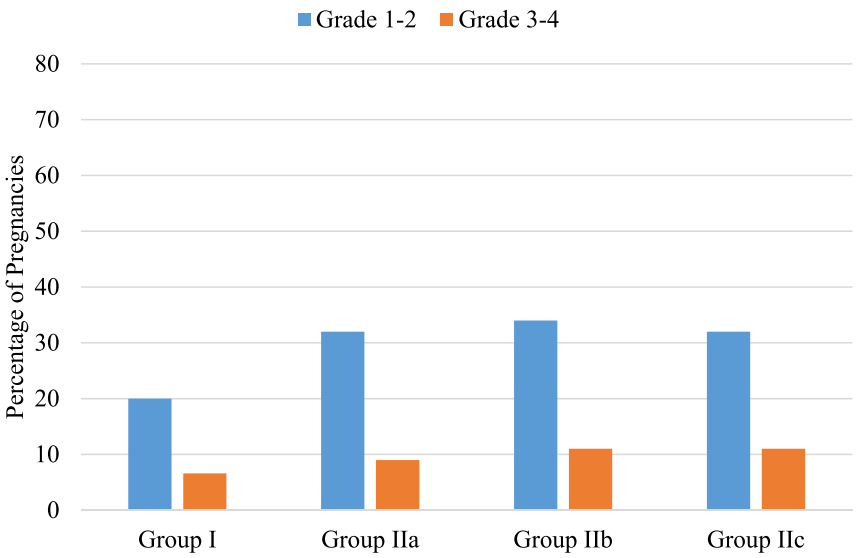

Fig. 1. Nair's classification.

variation among study categories as regard years old 26.68 ± 4.64 verses 26.49 ± 4.25 years, gestational age 38.3 ± 0.93 verses 38.46 ± 0.89 weeks, gravidity 2.0 verses 2.0, and parity one verses one with *P* value 0.37, 0.101, 0.257 and 0.067. No statistically important variation was shown among categories regarding the gravidity and parity.

Moreover, Mohanty and Anand,[7] reported that majority of studied cases (68%) were under age of 30. Only 32 of 100 studied cases were 30 years old. Research patients' mean years old were 29.06 ± 3.1.

In the current study, the overall incidence of adhesions in category I was 26.7%, while adhesions were detected in 43.6% of pregnancies in group II. A statistically important variation was shown among categories regarding adhesion incidence, patients with higher BMI were more likely to develop intraabdominal adhesions. The incidence of adhesions was 27%, 34%, 49%, and 60% in groups I, IIa, IIb, and IIc, respectively, a positive correlation was found between BMI and incidence of adhesions. The correlation was statistically significant.

Our findings are supported by Tulandi and colleagues,[1] which reported that in primary CS, no adhesions were discovered. Compared with females who had second CS (24.4%), significantly more females had adhesions after three CSs (42.8%; 95% CI, 0.84–0.99). Delivery time was significantly longer at subsequent CSs compared with first CS (7.7 ± 0.3 min; 95% CI, 1–2); second CS, 9.4 ± 0.1 min; 95% CI, 1–2; third CS, 10.6 ± 0.3 min; 95% CI, 2–4; greater than or equal to four CSs, 10.4 ± 0.1 min; 95% CI, 1–2). Risk of problems in females with more than or equal two CSs, on the other hand, were comparable to primary CS.

Also, Adhesions can grow larger and tighter over time, creating issues even years after surgery. Hesselman and colleagues,[8] reported that number of CS was important predictor of adhesions; progressive years old, obesity, and postpartum infection further improved incidence.

Also, in agreement with our study, Dogan and colleagues,[9] discovered statistically significant link among abdominal adhesions and previous CS (positive correlation).

On the contrary, Gungor and colleagues,[10] found no statistical differences between intraabdominal adhesions in terms of age of the patient, or the number of previous CS. In agreement with our study, Gungor and colleagues,[10] and Dogan and colleagues,[9] found no statistical differences between intraabdominal adhesions and BMI. Such differences in the results would be rendered to different patient grouping in different studies.

Table 3. Postoperative results (N = 232).

	Group I (*N* = 30)	Group II (*N* = 202)	*P* value
Hemoglobin (g/dl) [a]			
Preoperative	12.2 ± 1.3	12.3 ± 1.2	0.968*
Postoperative	11.9 ± 1.4	10.1 ± 0.9	0.031*
Difference	0.3 ± 0.1	2.2 ± 0.2	0.001*
P value**	0.083	0.004	
Visceral Injury [b]			0.002***
Yes	2 (6.7)	30 (14.9)	
No	28 (93.3)	172 (85.1)	

* Independent sample t examination.
** Paired sample t examination.
*** Chi-square examination.
[a] Data are presented as mean ± standard deviation.
[b] Data are presented as frequency (percentage).

In research, dense adhesions were shown in six (20%) pregnancies in group I, 21 (22%) in group IIa, 19 (23%) in group IIb, and six (24%) in group IIc. No statistically important variation was shown among four categories regarding incidence of dense adhesion.

Fouad and colleagues,[6] found that regarding scar thickness and shape; statistical analysis of current results found that there was no statistically important variation among study categories as considered scar thickness *P* value 0.067, depressed scar was nonsignificant more frequent 16 (15.2%) verses 6 (5.7%) and hypertrophied scar was nonsignificant less frequent in obese cases 76 (72.4%) verses 85 (81.0%) with *P* value 0.079. Flat scar was nonsignificant less frequent in obese cases 13 (12.4%) verses 14 (13.3%).

In the study on our hands, grade 1 or 2 adhesion were found in 20% of group I, 32% of group IIa, 34% of group IIb, and 32% of group IIc. Grade 3 or 4 adhesions were found in 6.6% of group I, 9% of group IIa, 11% of group IIb, and 11% of group IIc. No statistically important variation was shown among categories considering Nair's classification.

In a harmony with research of Fouad and colleagues,[6] which informed that in obese cases, scar thickness was significantly higher 8.7 ± 1.2 verses 7.3 ± 1.1 mm, different adhesion sites (uterus-bladder, omentum-fascia, uterus-omentum and uterus-fascia) were significantly more frequent, dense adhesion consistencies were more frequent and adhesion size was higher in obese cases. Operative duration was significantly longer in obese cases 40.0 ± 3.0 vs. 36.9 ± 4.0 min Operative complications were non-significantly more frequent in obese cases.

In the current study; we sound that no statistically important variation was shown among categories considering preoperative Hgb. However, group II was associated with more significant blood loss compared with group I. Furthermore, the incidence of intraoperative visceral injuries was higher in category II compared with category I, amount of haemoglobin loss was 0.3 ± 0.1 in group I, 1.5 ± 0.1 in group IIa, 2.5 ± 0.2 in group IIb, and 3.5 ± 0.3 in group IIc. The incidence of visceral injury was 6.7% in category I, 10% in category IIa, 18% in category IIb, and 20% in category IIc.

Fouad and colleagues,[6] reported that as regard postoperative hemoglobin (mg/dL) and blood transfusion; statistical analysis of current outcomes found that there were no important differences according to BMI regarding postoperative hemoglobin 10.53 ± 1.09 verses 10.77 ± 1.01 and hemoglobin drop 0.9 ± 0.7 verses 0.78 ± 0.59 with *P* value 0.052 and 0.097. Blood transfusion was not recorded in all cases.

Current study disagreed with Saadia,[11] who stated that regarding bladder injuries, three pregnant women with BMI more than or equal to 30 kg/m^2 suffered from bladder injury representing 1.5% of cases in the studied group. On the other hand, no pregnant women with BMI less than 30 suffered from bladder injuries. However, there was no statistically important variation among both categories with *P* value = 1.

Current study agreed with Smid and colleagues,[12] who stated that In contrast to risk of postcesarean problems, risk of 60 intraoperative problems does not seems to be enlarged in obese females, and even 61 in super obese females.

Current study agreed with Machado,[13] who discussed complications of CSs in obese women. They studied 971 cases; the cases were separated into 4 categories according to BMI into women with BMI 40 kg/m^2. Only 1 woman only in the group of cases with BMI 35–39.9 kg/m^2 suffered from bowel injury. This difference was statistically insignificant with *P* value = 0.5.

5. Conclusion

In women undergoing CS, there was a significant association between body mass index and formation of intra-abdominal adhesion.

Consent for publication

I verify that all authors have agreed to submit manuscript.

Availability of data and material

Available.

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Conflict of Interest

Authors declare that they have no conflicts of interest with regard to publication of this paper.

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