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Association between characteristics of previous cesarean delivery and pelvic adhesions: a case-controlled study

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ABSTRACT

Objectives: To assess the correlation of previous cesarean delivery characteristics to pelvic adhesions in infertile patients.

Material and methods: This Case-controlled study was conducted in the period from January 2018 to December 2020 at Tanta University. All patients (222) presenting with post-cesarean infertility who underwent diagnostic laparoscopy were included in the study. According to presence of adhesions during laparoscopy, two groups were allocated. Characteristics of previous cesarean delivery were assessed in patients with or without adhesions.

Results: There were significant differences between both groups regarding type of CS, shape of skin scar, parietal peritoneal closure, and postoperative complications of the prior CS between both groups. Independent predictors of adhesions were age [OR: 1.43 (1.15–1.77); p = 0.001], BMI [OR: 0.76 (0.61–0.95); p = 0.02], emergency CS [OR: 7.74 (1.61–37.19); p = 0.01], parietal peritoneal closure [OR: 0.06 (0.01–0.24); p = 0.001].

Conclusions: Post-cesarean adhesions were correlated to age, BMI, emergency CD, double layer closure, and closure of peritoneum and to postoperative complications. No correlation to duration of infertility or number of cesarean sections.

Key words: pelvic adhesions; post-cesarean infertility; peritoneal closure; characteristics; postoperative complications

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INTRODUCTION

Cesarean delivery (CD) is one among the foremost common surgeries. The quantity of CDs performed has augmented within the past decade, with a current rate of roughly 33% of all births within the USA and 26% in Africa, Asia and Latin America [1]. Adhesions are common complication following major abdominal surgery, together with CD. Adhesions occur during healing and is formed from fibrous connective tissue that abnormally connect internal organs or structures to each other [2].

Many complications are associated with abdominal adhesions leading to significant maternal morbidity. The reported complications may lead to intestinal obstruction, secondary infertility, chronic pelvic pain, and sometimes require readmission to operative room. The postulated mechanisms of chronic pelvic pain may be due to traction on organs, continuous peritoneal irritation or superimposed infection while the postulated mechanisms for infertility was the anatomical disturbance or tubal block and abnormal tubo-ovarian relationship [2, 3].

Many studies investigated the incidence of post-cesarean adhesions where wide range was reported. Some studies reported that adhesions were increased with increasing number of repeat cesarean sections and led to more surgical difficulties [4]. Other studies reported adhesion formation with a rate of 24.7% after the first cesarean section while higher adhesion formation rates of up to 73.13% after the primary cesarean delivery were reported [5–7].

The etiopathogenesis of adhesions is usually difficult to prove, surgical trauma along with proinflammatory mechanisms were among reported complications to be associated with adhesions. Understanding the pathophysiology of adhesion development helped scientists to develop evidence-based approach to prevent and treat intra-abdominal adhesions [8]. The suggested risk factors in the etiopathogenesis of abdominal and pelvic adhesions were individual

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propensity, residual blood and vernix caseosa, the number of cesarean sections and postoperative infection [9, 10]. The best method to reduce adhesions formation is to choose the correct surgical technique and minimize trauma to adjacent organs [8].

The current study was conducted to investigate the correlation of proposed risk factors in the pathogenesis of pelvic adhesions.

MATERIAL AND METHODS

Study design and settings

This study is a case-controlled study conducted at Tanta University, Tanta, Egypt in the period from January 2018 to December 2020.

Patients

Data of infertile patients managed by diagnostic laparoscopy were reviewed. Inclusion criteria included single cesarean delivery; age between 20–40 years, singleton pregnancy, and normal other infertility investigations e.g., Semen, hormonal profile and ultrasound pelvic examination. The exclusion criteria were any associated medical conditions during pregnancy such as hypertension or diabetes, associated gynecological lesions such as myomas, ovarian cysts during pregnancy, patients with missed operative cards or files, patients with any coagulation defects or under anticoagulant therapy during pregnancy and patients with other abdominal surgeries.

Sample size calculation

Assuming equal size of both groups, odd ratio = 1, 90% statistical power and a 5% margin of error. The Epi Info, a program developed by the Centers for Disease Control and Prevention was used to calculate sample size. The calculated sample was 95 in each group.

Allocations

Eligible patients were allocated into either study group who had adhesions at laparoscopy or control group who had no adhesions at laparoscopy.

Methods

All patients demographic data were reviewed. Regarding cesarean delivery the place of surgery, type of cesarean whether elective or emergency, peritoneal closure, uterine closure, blood loss, and postoperative complications. The current data also were recorded such as sites and nature of adhesions, duration of infertility, and shape of skin scar.

Statistical methods

We used STATA 16.1 (Stata Corp-College Station-TX--USA) to perform all the statistical analyses. The normality of the continuous variables was tested using the Shapiro--Wilk test. Non-normally distributed continuous variables were presented as median (25th and 75th percentiles) and compared with the Mann-Whitney test. Ordinal and binary data were presented as frequencies and percentages and compared with the Chi-square or Fisher exact test if the expected frequency was less than 5. A stepwise multivariable logistic regression analysis with a forward selection and entry p value of 0.05 or less was performed to identify factors associated with adhesions. Model calibration was tested using the Hosmer-Lemeshow test and calibration with C-statistics and area under the curve. A p value of less than 0.05 was considered statistically significant.

RESULTS

Patients were allocated according to the presence of adhesion at the time of CS into two groups. Control group (n = 98) included patients with no adhesions, and Study group included patients with adhesions (n = 104).

Baseline data

Patients who developed adhesions were significantly older and had lower body mass index (BMI) (Fig. 1). There were significant differences in the type of CS, shape of skin scar, parietal peritoneal closure, and postoperative complications of the prior CS between both groups. We did not find differences between groups regarding other baseline variables (Tab. 1).

Uterine adhesions occurred in 70 patients (67.31%), ovarian adhesions in 54 patients (51.92%), and tubal adhesions in 62 patients (59.61%). The adhesions were filmy in 30 (29.7%) patients and dense in 71 (70.30%) patients (Fig. 2).

Factors associated with adhesions

Univariable analysis for factors associated with adhesions is presented in Table 2. Independent predictors of adhesions were age [OR: 1.43 (1.15–1.77); p = 0.001], BMI [OR: 0.76 (0.61–0.95); p = 0.02], emergency CS [OR: 7.74 (1.61–37.19); p = 0.01], parietal peritoneal closure [OR: 0.06 (0.01–0.24); p = 0.001], healing of the skin scar by secondary intention [OR: 12.67 (2.36–67.93); p = 0.003], hypertrophied skin scar [OR: 41.17 (7.45–227.45); p < 0.001], keloid [OR: 27.55 (4.84–156.68); p < 0.001] and postoperative fever [OR: 13.94 (2.27–85.63); p = 0.004] (Tab. 2).

DISCUSSION

Pelvic adhesions that occur following abdominal surgery remain a great problem especially in females in reproductive age owing to its deleterious effects on subsequent fertility. Adhesions may follow many gynecological operations and cesarean delivery (CD) although some authors reported little incidence of adhesions after cesarean delivery (CD) [5, 9].

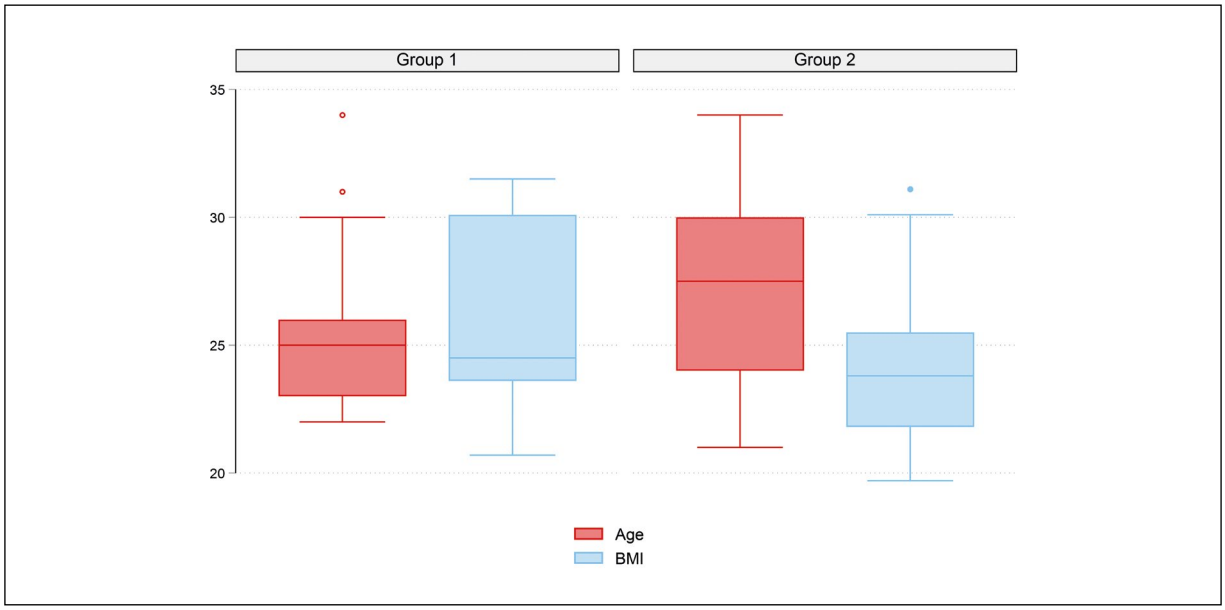

Figure 1. Box plot of age and body mass index (BMI) by group; Group 1: patients with no adhesion- Group 2: patients with adhesions

Table 1. Baseline data

	Control group 1 (n = 98) No adhesions group	Study group 2 (n = 104) Adhesions group	p value
Age [years]	25 (23–26)	27.5 (24–30)	0.002
BMI [kg/m^2]	23.8 (21.8–25.5)	24.5 (23.6–30.1)	< 0.001
Parity 2 3 4	 37 (37.76%) 39 (39.8%) 22 (22.45%)	 32 (30.77%) 47 (45.19%) 25 (24.04%)	0.57
Number of CS 1 2 3	 46 (46.94%) 41(41.84%) 11 (11.22%)	 56 (53.85%) 33 (31.73%) 15 (14.42%)	0.072
Duration of infertility [years]	4 (3–5)	3 (3–5)	0.45
Places of last CS Private hospital General hospital University hospital	 53 (54.08%) 32 (32.65%) 13 (13.27%)	 56 (53.85%) 36 (34.61%) 12 (11.54%)	0.97
Type of CS Emergency Elective	 23 (23.47%) 75 (76.53%)	 91 (87.50%) 13 (12.50%)	< 0.001
Parietal peritoneal closure (yes)	77 (78.57%)	7 (6.73%)	< 0.001
Uterine layers Single Double	 21 (21.43%) 77 (78.57%)	 21 (20.19%) 83 (79.81%)	0.83
Skin scar Normal Healed with secondary intention Hypertrophied Keloid	 71 (72.45%) 13 (13.27%) 7 (7.14%) 7 (7.14%)	 5 (4.81%) 34 (32.69%) 46 (44.23%) 19 (18.27%)	< 0.001
Postoperative complications No Fever Wound sepsis PPH	 18 (18.37%) 37 (37.76%) 36 (36.73%) 7 (7.14%)	 5 (4.81%) 31 (29.81%) 44 (42.31%) 24 (23.08%)	< 0.001

Continuous data were presented as median (25th and 75th percentiles) and categorical data as numbers and percentages. Group 1: patients with no adhesion. Group 2: patients with adhesions; BMI — body mass index; CS — cesarean section; PPH — postpartum hemorrhage

Several risk factors were studied to reach solid evidence regarding the pathogenesis of pelvic adhesions. Technique of cesarean wound closure, number of cesarean sections, obesity, blood loss, length of surgery and postoperative infection. Scar shape of previous surgery and keloid formation were also studied to predict presence of abdominal adhesions. Surgeon skills and individual variations were also addressed [11–17].

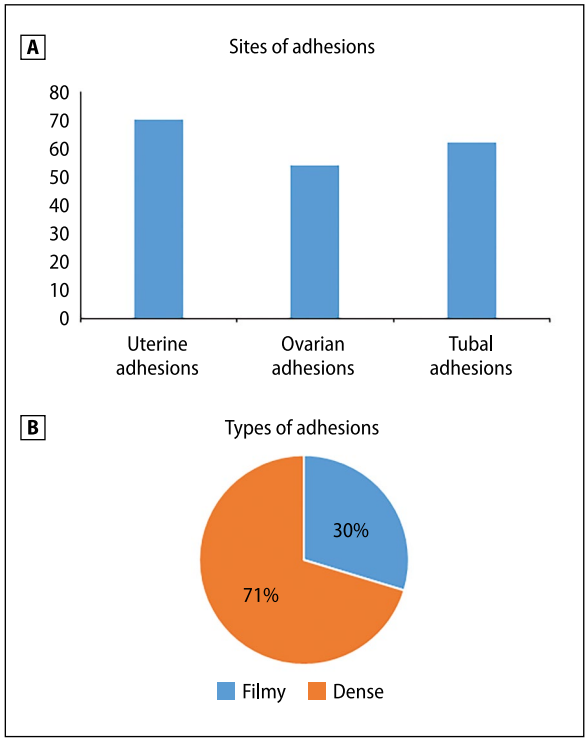

Figure 2. A. Sites of adhesions; **B.** Types of adhesions

In the current study, we investigated the risk factors that may be implicated in the etiopathogenesis of pelvic adhesions. The basal demographic data investigated were age, parity, and BMI where positive correlation was noticed with age and BMI while no correlation was noticed with parity. Also, no significant correlation to duration of infertility or place of prior CD.

We investigated the correlation of adhesions to number of cesarean deliveries, where no correlation was found with increased number of CD. This finding agrees with Dawood et al who found no correlation to number of CD [7]. This finding is not in agreement with the results of other studies which found that not only the incidence of adhesions increase with repeat CD but also the density of adhesions increase [3, 12]. Other study found that there is no correlation between number of CD and pelvic adhesions and the formation of adhesions may be due to individual factors [17].

Type of CD whether elective or emergency was investigated in the current study. Emergency CD was correlated to more pelvic adhesions owing to more blood loss, rapid opening of abdomen and higher infection rates. This finding is not in agreement with Herzberger et al. who reported no correlation between type or time of CD and subsequent pelvic adhesions [17]. Similar results were reported by Dawood et al. [7].

Table 2. Logistic regression for factors associated with adhesions

	Univariable analysis		Multivariable analysis	
	OR (95% CI)	p value	OR (95% CI)	p value
Age	1.18 (1.08–1.28)	< 0.001	1.43 (1.15–1.77)	0.001
BMI	0.82 (0.75–0.90)	< 0.001	0.76 (0.61–0.95)	0.02
Parity	1.17 (0.42–0.81)	0.42	–	–
Number of CS	1.21 (0.78–1.89)	0.40		
Duration of infertility	0.94 (0.56–0.78)	0.56	–	–
Place of last CS	1.01 (0.58–1.76)	0.97	–	–
Emergency CS	22.83 (10.83–48.11)	< 0.001	7.74 (1.61–37.19)	0.01
Parietal peritoneal closure	0.02 (0.008–0.05)	< 0.001	0.06 (0.01–0.24)	0.001
Double uterine layers	1.08 (0.55–2.13)	0.83	–	–
Skin scar				
Healing by secondary intention	37.14 (12.25–112.63)	< 0.001	12.67 (2.36–67.93)	0.003
Hypertrophied scar	93.31 (27.94–311.71)	< 0.001	41.17 (7.45–227.45)	< 0.001
Keloid	38.54 (11–135.11)	< 0.001	27.55 (4.84–156.68)	< 0.001
Postoperative complications			–	
Fever	3.02 (1.0–9.06)	0.049	13.94 (2.27–85.63)	0.004
Wound sepsis	4.4 (1.45–13.01)	0.02	–	–
PPH	12.34 (3.6–453)	< 0.001	–	–

Area under the curve = 0.97; Hosmer-Lemeshow p value = 0.65; Pseudo R-squared = 0.69; BMI — body mass index; CI — confidence interval; OR — odds ratio; OR — odds ratio; PPH — postpartum hemorrhage

Regarding technique of CD, we found that double layer closure of uterus did not have significant reduction in pelvic adhesions. This finding does not agree with the results of Joergensen et al. who reported that double closure reduced pelvic adhesions, but their study was case reports only with three cases [18].

Another debate in the technique of CD is the peritoneal closure. In the current study, peritoneal closure was associated with little incidence of pelvic adhesions. This agrees with recent meta-analysis results comparing adhesions following peritoneal closure or non-closure. They concluded that significant reduction in adhesions was detected after closure of the peritoneum. Also, they reported that not only peritoneal closure to be put in mind as a sole factor for adhesions formation as CD had a lot of technique modifications [19–23].

On the other side, our results are opposite to Takreem et al. who observed that adhesions were less following peritoneal non-closure. In addition, non-closure of peritoneum reduced operative time and anesthesia duration and led to early hospital discharge [24–26].

In the current study, we found strong correlation between shape of CS scar and presence of adhesions. The studied criteria were healed scar by secondary intension (depressed), keloid and hypertrophied scar. Our results agree with other studies which correlate abdominal scar characteristics to presence and severity of intra-abdominal adhesions. These studies found strong correlation between depressed cesarean scars and intra-abdominal adhesions. Moreover, another authors found strong correlation between palpable cesarean scar and pelvic adhesions [15, 25, 27–31].

In the current study, postoperative complications like postoperative wound sepsis, postpartum hemorrhage and fever were linked to significant pelvic adhesions. This finding agreed with that of Moro et al. who found strong correlation between postoperative complications and presence of pelvic adhesions [6]. On the other hand, Soltan et al. did not find an association between a history of postoperative complications and pelvic adhesions [32].

CONCLUSIONS

In conclusion, post-cesarean adhesions lead to secondary infertility. Formation of adhesions was correlated to age, BMI as well as to type of CD, peritoneal closure, and double layer closure and to postoperative complications including cesarean scar shape. No correlation was found with duration of infertility, place of CD and to number of CD. Further studies are required to add to the evidence to give a solid conclusion regarding these factors to minimize formation of pelvic adhesions and consequently related infertility.

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Ethics

This study was conducted in accordance with the Declaration of Helsinki and ethics approval from Tanta University ethical committee with the following code 35908.

Consent to participate

Consent was taken from all patients included in the study.

Data Sharing Statement

Authors agree to share participant data, on reasonable request, by contacting Ayman Shehata Dawood[1], M.D.

Conflict of interests

All authors declare no conflict of interest.

REFERENCES

1. Walfisch A, Beloosesky R, Shrim A, et al. Adhesion prevention after cesarean delivery: evidence, and lack of it. Am J Obstet Gynecol. 2014; 211(5): 446–452, doi: 10.1016/j.ajog.2014.05.027, indexed in Pubmed: 24858198.
2. Elgergawy AE, Elhalwagy AE, Salem HA, et al. Outcome of laparoscopic adhesiolysis in infertile patients with pelvic adhesions following cesarean delivery: a randomized clinical trial. J Gynecol Obstet Hum Reprod. 2021 May 1.; 50(5): 101969, doi: 10.1016/j.jogoh.2020.101969, indexed in Pubmed: 33147492.
3. Morales KJ, Gordon MC, Bates GW. Postcesarean delivery adhesions associated with delayed delivery of infant. Am J Obstet Gynecol. 2007; 196(5): 461.e1–461.e6, doi: 10.1016/j.ajog.2006.12.017, indexed in Pubmed: 17466702.
4. Rossouw JN, Hall D, Harvey J. Time between skin incision and delivery during cesarean. Int J Gynaecol Obstet. 2013; 121(1): 82–85, doi: 10.1016/j.ijgo.2012.11.008, indexed in Pubmed: 23340272.
5. Poole JH. Adhesions following cesarean delivery: a review of their occurrence, consequences and preventative management using adhesion barriers. Womens Health (Lond). 2013; 9(5): 467–477, doi: 10.2217/whe.13.45, indexed in Pubmed: 24007252.
6. Moro F, Mavrelos D, Pateman K, et al. Prevalence of pelvic adhesions on ultrasound examination in women with a history of Cesarean section. Ultrasound Obstet Gynecol. 2015; 45(2): 223–228, doi: 10.1002/uog.14628, indexed in Pubmed: 25042444.
7. Dawood AS, Elgergawy AE. Incidence and sites of pelvic adhesions in women with post-caesarean infertility. J Obstet Gynaecol. 2018; 38(8): 1158–1163, doi: 10.1080/01443615.2018.1460583, indexed in Pubmed: 29882442.
8. Buţureanu SA, Buţureanu TA. Pathophysiology of adhesions. Chirurgia (Bucharest, Romania: 1990). 2014 May 1;109(3):293-8, indexed in Pubmed: 24956331.
9. Awonuga AO, Fletcher NM, Saed GM, et al. Postoperative adhesion development following cesarean and open intra-abdominal gynecological operations: a review. Reprod Sci. 2011; 18(12): 1166–1185, doi: 10.1177/1933719111414206, indexed in Pubmed: 21775773.
10. Shenhav S, Grin L, Kapustian V, et al. Quantifying the effects of postcesarean adhesions on incision to delivery time. J Matern Fetal Neonatal Med. 2019; 32(15): 2500–2505, doi: 10.1080/14767058.2018.1439010, indexed in Pubmed: 29415600.
11. Hinterleitner L, Kiss H, Ott J. The impact of Cesarean section on female fertility: a narrative review. Clin Exp Obstet Gynecol. 2021 Aug 11. ; 48(4): 781–6, doi: 10.31083/j.ceog4804125.
12. Tulandi T, Agdi M, Zarei A, et al. Adhesion development and morbidity after repeat cesarean delivery. Am J Obstet Gynecol. 2009; 201(1): 56.e1–56.e6, doi: 10.1016/j.ajog.2009.04.039, indexed in Pubmed: 19576375.

13. Stark M, Hoyme UB, Stubert B, et al. Post-cesarean adhesions-are they a unique entity? J Matern Fetal Neonatal Med. 2008; 21(8): 513–516, doi: 10.1080/14767050802040823, indexed in Pubmed: 18609356.
14. Doherty DA, Magann EF, Chauhan SP, et al. Factors affecting caesarean operative time and the effect of operative time on pregnancy outcomes. Aust N Z J Obstet Gynaecol. 2008; 48(3): 286–291, doi: 10.1111/j.1479-828X.2008.00862.x, indexed in Pubmed: 18532960.
15. Salim R, Kadan Y, Nachum Z, et al. Abdominal scar characteristics as a predictor of intra-abdominal adhesions at repeat cesarean delivery. Fertil Steril. 2008; 90(6): 2324–2327, doi: 10.1016/j.fertnstert.2007.10.037, indexed in Pubmed: 18178195.
16. Kinay T, Savran Uc, Ramoglu S, et al. Maternal obesity and intra-abdominal adhesion formation at cesarean delivery. J Matern Fetal Neonatal Med. 2020 Jun; 30: 1–6, doi: 10.1080/14767058.2020.1783231, indexed in Pubmed: 32586147.
17. Herzberger EH, Alon H, Hershko-Klement A, et al. Adhesions at repeat cesarean delivery: is there a personal impact? Arch Gynecol Obstet. 2015; 292(4): 813–818, doi: 10.1007/s00404-015-3718-x, indexed in Pubmed: 25877223.
18. Joergensen SL, Settnes A. Post-cesarean adhesion syndrome. J Gynecol Surg. 2019 Oct 1. ; 35(5): 314–7, doi: doi.org/10.1089/gyn.2018.0102.
19. Cheong YC, Premkumar G, Metwally M, et al. To close or not to close? A systematic review and a meta-analysis of peritoneal non-closure and adhesion formation after caesarean section. Eur J Obstet Gynecol Reprod Biol. 2009; 147(1): 3–8, doi: 10.1016/j.ejogrb.2009.06.003, indexed in Pubmed: 19596507.
20. Chanrachakul B, Hamontri S, Herabutya Y. A randomized comparison of postcesarean pain between closure and nonclosure of peritoneum. Eur J Obstet Gynecol Reprod Biol. 2002; 101(1): 31–35, doi: 10.1016/s0301-2115(01)00503-6, indexed in Pubmed: 11803097.
21. Practice Committee of the American Society for Reproductive Medicine in collaboration with the Society of Reproductive Surgeons. Pathogenesis, consequences, and control of peritoneal adhesions in gynecologic surgery. Fertil Steril. 2008 Nov 1.; 90(5): S144–9, doi: 10.1016/j.fertnstert.2008.08.060, indexed in Pubmed: 19007613.
22. CAESAR Study Collaborative Group. Caesarean section surgical techniques: a randomised factorial trial (CAESAR). BJOG. 2010 Oct.; 117(11): 1366–76, doi: 10.1111/j.1471-0528.2010.02686.x, indexed in Pubmed: 20840692.
23. Qiong-qiong NI. Clinical Analysis of 113 Cases with Peritoneal Adhesion After Cesarean Section. Med Recap.; 2008: 5.
24. Takreem A. Comparison of peritoneal closure versus non-closure during caesarean section. J Ayub Med Coll Abbottabad. 2015; 27(1): 78–80, indexed in Pubmed: 26182743.
25. Seyam E, Ibrahim EM, Youseff AM, et al. Laparoscopic Management of Adhesions Developed after Peritoneal Nonclosure in Primary Cesarean Section Delivery. Obstet Gynecol Int. 2018; 2018: 6901764, doi: 10.1155/2018/6901764, indexed in Pubmed: 29487625.
26. Sholapurkar SL. Can the practice of nonclosure of visceral and parietal peritoneum during cesarean delivery be justified? Am J Obstet Gynecol. 2015; 212(4): 550, doi: 10.1016/j.ajog.2014.12.008, indexed in Pubmed: 25511240.
27. Kahyaoglu I, Kayikcioglu F, Kinay T, et al. Abdominal scar characteristics: do they predict intra-abdominal adhesions with repeat cesarean deliveries? J Obstet Gynaecol Res. 2014; 40: 1643–1648, doi: 10.1111/jog.12429, indexed in Pubmed: 24888928.
28. Stocker LJ, Glazebrook JE, Cheong YC. Are skin scar characteristics associated with the degree of pelvic adhesions at laparoscopy? Fertil Steril. 2014; 101(2): 501–505, doi: 10.1016/j.fertnstert.2013.10.026, indexed in Pubmed: 24289993.
29. Pergialiotis V, Frountzas M, Siotos C, et al. Cesarean wound scar characteristics for the prediction of pelvic adhesions: a meta-analysis of observational studies. J Matern Fetal Neonatal Med. 2017; 30(4): 486–491, doi: 10.1080/14767058.2016.1176135, indexed in Pubmed: 27072887.
30. Taylan E, Akdemir A, Ergenoglu AM, et al. Can we predict the presence and severity of intra-abdominal adhesions before cesarean delivery. Gynecol Obstet Invest. 2017; 82(6): 521–526, doi: 10.1159/000454767, indexed in Pubmed: 27997914.
31. Chrelias G, Pergialiotis V, Oikonomou M, et al. Correlation of cesarean section scar characteristics with intra-abdominal adhesions–A prospective cohort study. Eur J Obstet Gynecol Reprod Biol. 2019 Mar 1. ; 234: e115, doi: 10.1016/j.ejogrb.2018.08.411.
32. Soltan MH, Al Nu, Khashoggi T, et al. Sequelae of repeat cesarean sections. Int J Gynaecol Obstet. 1996; 52: 127–132, doi: 10.1016/0020-7292(95)02561-8, indexed in Pubmed: 8855090.