Original Research Article

Evaluation of the complications of the *in situ* versus uterine exteriorization repair of caesarean section uterine incision

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ABSTRACT

Background: caesarean section is the most performed major operation around the world. In this study we aim to compare *in situ* repair of caesarean section uterine incision to repair with uterine exteriorization.
Methods: The study was conducted on 200 patients at El-Shatby maternity university hospital during the period from June 2019 to June 2020 and after ethical committee approval and obtaining an informed consent. All cases were 37 weeks gestation or more with singleton fetus prepared to have caesarean section. They were randomly allocated into 2 groups each of 100 participants: group A: with exteriorization repair of the uterus, group B: with in situ repair. After history taking, examination and laboratory investigations, elective caesarean section was done under spinal anesthesia. After delivery of the fetus and placenta, the uterus was repaired either *in situ* or after exteriorization followed by closure of the abdomen in layers. We assessed: primary outcome: blood loss. secondary outcome: nausea or vomiting, hypotension, operative time and duration of uterine repair, tachycardia, uterine contractility and hematoma formation. Post-operative pain, febrile illness, time of ambulation, time of return of bowel function were also assessed. Data were collected and submitted to statistical analysis.
Results: *In situ* repair had a statistically significant decrease in intra operative nausea, vomiting and tachycardia. Exteriorization resulted in significantly shorter duration of uterine repair; unlikely duration of the whole surgery was not statistically significant. Return of intestinal sounds was statistically significant in favour of *in situ* repair.
Conclusions: There is no definite or absolute privilege of *in-situ* repair versus exteriorization.

Keywords: Caesarean section, Uterine incision, *In-situ* repair, Uterine exteriorization

INTRODUCTION

Caesarean section is the delivery of the fetus through a surgically created incision in anterior uterine wall.[1] Closed either with uterine exteriorisation or *in-situ* repair with no reported significant differences in blood loss, febrile complications, surgical time and pain. Both are reasonable, depending on practitioner preference.[2]

Caesarean section has reported short-term complications as intra-and post-partum hemorrhage, infection and infectious complications as high fever, wound infection, endometritis and urinary tract infection.[3-5] Pelvic abscess, septicemia, and septic shock, necrotizing fasciitis, and septic pelvic vein thrombophlebitis.[6] Vascular thromboembolism and operative injuries are also reported.[3]

Long-term complications were also reported as keloids, adhesions, uterine adhesions and uterine CS defect (CSD) or "niche", scar ectopic pregnancy and placenta accreta in a subsequent pregnancy.[7-13]

In this study we aim at evaluating the complications of *in situ* repair of caesarean section uterine incision versus uterine exteriorization.

METHODS

A clinical randomized prospective study was conducted on 200 patients during the period from June 2019 to June 2020 at El-Shatby university hospital after approval of the ethical committee of Alexandria faculty of medicine (Approval number:2018-117860) and obtaining an informed consent. Patient anonymity was preserved.

Inclusion criteria included

Elective cesarean delivery, 37 weeks gestation or more, cephalic presentation, singleton fetus included in the study.

Exclusion criteria included

Cases at risk of uterine atony and/or postpartum hemorrhage (multiple gestation, placenta accrete, placenta previa, preeclampsia, eclampsia, uterine leiomyomata, polyhydramnios), morbid obesity (BMI>35 kg/m^2), coagulopathy, cases in active labor or requiring emergency caesarean section were excluded from the study.

Participants were randomly allocated into 2 groups: Group A: 100 women with exteriorization repair of uterine incision, group B: 100 women with *in situ* repair of uterine incision.

After history taking, clinical and ultrasound examination, laboratory investigations (complete blood count, blood group and Rh, coagulation studies, fasting blood sugar and complete urine analysis) were done.

Preoperative hydration using intravenous 1000 ml Ringer's lactate solution with intravenous antibiotic (cefotaxim 2 gm) followed by spinal anesthesia.

Sterilization of surgically prepared area with povidone iodine (Betadine). Opening of the skin and the subcutaneous tissue through pfannenstiel incision and incising the fascia and the rectus sheath followed by rectus muscles separation and opening the peritoneum.

Lower segment c-shaped incision was done and the amniotic membranes were incised.

Delivery of the fetus and placenta followed by administration of intravenous uterotonics and separation of the placenta by controlled cord traction technique. Repair of the uterus by two layers closure with careful heomostasis either in situ or after exteriorization. Inspection of the uterine incision and the bladder flap. Suction of blood and amniotic fluid from para colic gutters. Sponges, laparotomy packs and instruments were counted.

Neither the visceral nor the peritoneal peritoneum was sutured, the rectus muscles were re-approximated. Rectus sheath was closed by continous non-locked absorbable sutures using vicryl 1 suture. Closure of subcutaneous tissue space only if more than 2 cm, skin edges approximated with running subcuticular proline suture.

During and after operation

Primary outcome measure

Hemoglobin levels before caesarean section and 6 hours postoperative to estimate the effect of the technique used on blood loss.

Actual blood loss (ABL) was calculated using a modification of the gross formula: ABL=BV [Hct (i)-Hct (f)]/ Hct (m).

Where BV the blood volume calculated using the equation (Blood volume=Body weight in kgs×70 mlkg-1), Hct (i) was the initial hematocrit, Hct (f) was final hematocrit and Hct (m) was mean hematocrit.[14]

Secondary outcome measures

Intra-operative nausea or vomiting, hypotensive episodes, duration of operation and duration of repairing the uterine incision (was calculated using a stopwatch), tachycardia (defined as a heart rate above 100 beats per minute), uterine contractility and additional use of oxytocics, surgical procedure (exposure and wound closure) and complications as hematoma formation.

Postoperative nausea or vomiting, postoperative pain assessed by the frequency of analgesic doses (analgesia was provided upon patient demand in the form of NSAID (declofenac sodium 75 mg (voltaren) by IM route) and the total administrated dose was calculated.

Postoperative febrile illness, time of ambulation, time of return of bowel function calculated by assessing the time of the first gas or bowel movement and by hearing intestinal peristalsis while checking the four abdominal quadrants with a stethoscope.

Data were collected and submitted to statistical analysis.

Statistical analysis of the data

By using IBM SPSS software package version 20.0 the data were fed to the computer.

Quantitative data were described using mean and standard deviation for normally distributed data while abnormally distributed data was expressed using median, minimum and maximum. Qualitative data were described using number and percent and comparison between different groups regarding categorical variables was tested using chi-square test.

For normally distributed data, comparison between two independent population were done using independent t-test

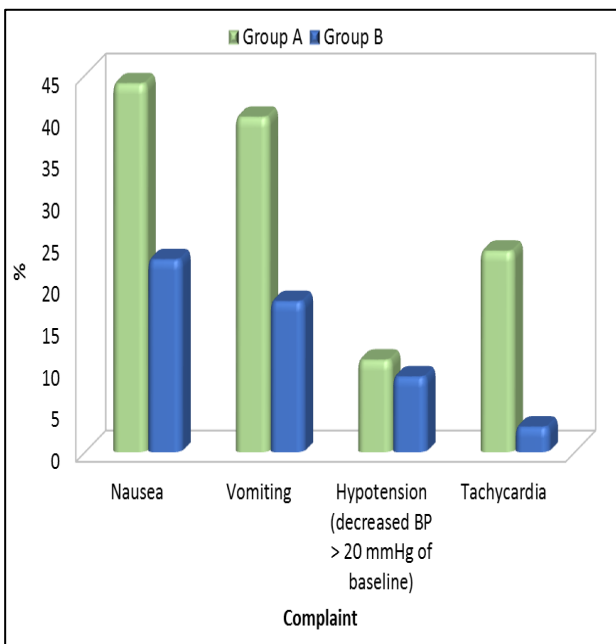while more than two population were analyzed by F test (ANOVA).

RESULTS

The two groups had no statistical difference regarding maternal age, gestational age and maternal weight, height and BMI. Age in both groups ranged from 20 to 27 years, p=0.219 (Table 1).

Intra-operative blood loss was not statistically significant where the estimated blood loss for the exteriorization group was 456±1683 mls compared to 505.2±172.4 mls in the *in-situ* repair group (p=0.465) (Table 1).

Preoperative mean haemoglobin was similar in both groups: group A was 10.6±0.7, and group B was 10.12±0.6 (p=0.425), post-operative mean haemoglobin in group A 10.1±0.7, and in group B 10.0±0.8. No significant difference was noticed (p=0.241) (Table 2).

Preoperative mean haematocrit (Ht%) was similar in both groups; in group A was 33.4±2.1, and in group B was 33.6±2.2, (p=0.165), post-operative Ht% in group A was 30.9±2.3, and in group B was 31.0±2.5 which was not statistically significant (p=0.211) (Table 3).

During the operation, patients were observed for the occurrence of the intra operative nausea and vomiting. Nausea occurred in about 23% of cases in the *in-situ* group and in about 44% of cases of the exteriorized group, with p=0.004 (Table 4 and Figure 1), while intra operative vomiting occurred in about 13% of cases in the *in-situ* group and in 40% in the exteriorized group, which was not statistically significant (p=0.001) (Table 4, Figure 1).

Blood pressure and pulse were monitored, hypotension occurred in 11% in exteriorization group and in 9% in the *in-situ* group with p=0.365 which was not statistically significant (Table 4). Tachycardia occurred in 24% in the exteriorization group and in 3% in the *in-situ* group, with p=0.001, which was statistically significant. (Table 4, Figure 1).

Uterine atony occurred in 6 cases in the exteriorization group compared to 4 cases in the *in-situ* group which was not statistically significant (p=0.516) (Table 4).

Uterine hematoma occurred in 4 cases in the exteriorization group and 5 cases in the *in-situ* group which was not statistically significant (p=0.733) (Table 4).

Both groups had no significant difference as regards number of vicryl ampoules required for uterine incision repair (p=0.634) (Table 5), in the *in-situ* group we used 1 ampoule of vicryl in 19 cases, 2 ampoules in 79 cases and 3 ampoules in 2 cases. In the exteriorized group we used 1 ampoule in 14 cases, 2 ampoules in 84 cases and 3 ampoules in 2 cases (Table 5).

We recorded the duration of uterine repair and we noticed that exteriorization of the uterus resulted in significantly shorter duration (5.4±1.7 min in the exteriorization group and 7.6±1.5 min in the *in-situ* group) p=0.001 (Table 5, Figure 2) unlikely, the duration of the whole surgery was not statistically significant, it was 27.3±5.0 min in exteriorization group and 25.6±31 min in the *in-situ* group (p=0.036) (Table 5).

Figure 1: Comparison between the two studied groups regarding patient complaint.
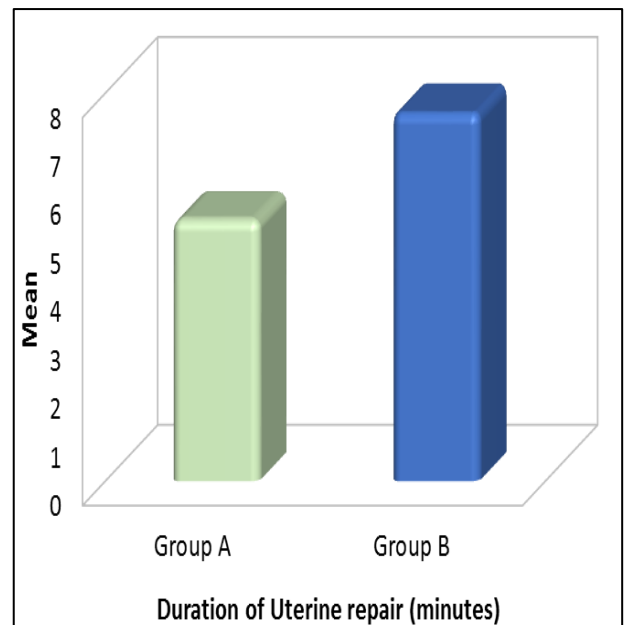
Figure 2: Comparison between the two studied groups regarding duration of uterine repair in minutes.

The need for analgesia was not significantly different between both groups (p=0.077) the mean dose in

exteriorized group was 231.4±548 mg of declofenac sodium while in *in-situ* group it was 221.2±46.1 (Table 5).

Nausea occurred in 46 cases in group A, and 30 cases in group B (p=0.012).

Vomiting occurred in 27 cases in exteriorization group, and in 20 cases in the *in-situ* group (p=0.036).

Uterine atony occurred in 3 cases in exteriorization group, and 4 cases in the *in-situ* group (p=0.48)

So, there was no statistically significant difference between the two groups regarding postoperative nausea, vomiting and uterine atony (Table 6).

Similarly, the timing of ambulation was not statistically significant; in exteriorization group, 51 cases started ambulation in less than 12 hours and 49 cases started ambulation after more than 12 hours. In the *in-situ* group, 47 cases started ambulation in less than 12 hours and 53 cases needed more than 12 hours to leave bed (p=0.682). (Table 7).

Postoperative fever as well, was not statistically different;

it occurred in 5 cases only in the exteriorization group compared to 7 in the *in-situ* group (p=0.48) (Table 7).

On the other hand, return of intestinal sounds was statistically significant; the mean in the exteriorization group was 14.9±3.2 compared to 9.7±3.3 in the *in-situ* group (p=0.219) (Table 6, Figure 3).
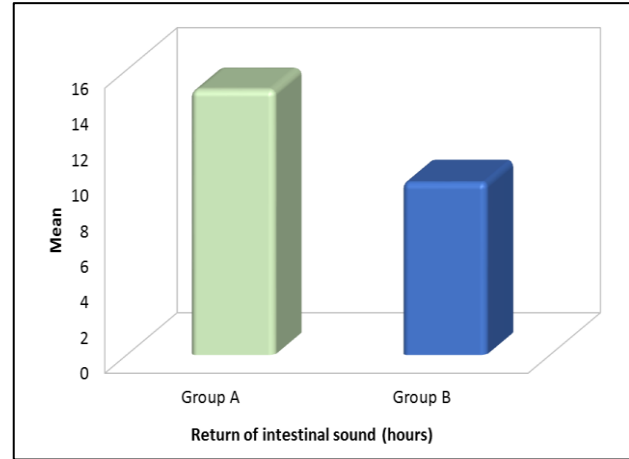

Figure 3: Return of intestinal sounds.

Table 1: Comparison between the two studied groups regarding demographic, basic data and amount of blood loss, (n=100).

Variables	Group A	Group B	T	P
Age (years)				
Range	20-27	21-26	0.925	0.219 N.S.
Mean ± SD	23.4±2.3	23.2±1.7		
Weight (kg)				
Range	62-91	62-91	1.36	0.115
Mean ± SD	78.1±8.8	76.6±9		
Height (cm)				
Range	155-172	154-171	1.21	0.211
Mean ± SD	164.5±4.4	164.0±4.1		
BMI (kg/m^2)				
Range	22.2-33.5	21.20-33.53	1.41	0.197
Mean ± SD	28.9±3.0	28.5±3.2		
Amount of blood loss				
Range	180-850	209.3-900	0.98	0.465
Mean ± SD	456.0±168.2	505.1±172.5		

T: Student t-test, p: p value for comparing between the two groups.

Table 2: Comparison between the two studied groups regarding pre and post-operative hemoglobin level, (n=100).

Variables	Group A	Group B	T	P
Hb level pre-operative (gm/dl)				
Range	9.55-11.93	8.99-11.85	0.89	0.425
Mean ± SD	10.6±0.7	10.12±0.6		
Hb level post-operative (gm/dl)				
Range	9.54-12	8.72-11.72	0.92	0.241
Mean ± SD	10.1±0.7	10.0±0.8		
Paired t	0.44	0.68		
P	0.52	0.63		

T: Student t-test, p: p value for comparing between the two groups.

Table 3: Comparison between the two studied groups regarding preoperative and post-operative mean hematocrit level, (n=100).

Variables	Group A	Group B	T	P
Ht% pre-operative (gm/dl)				
Range	30.1-37.7	30.11-37.87	1.03	0.165
Mean ± SD	33.4±2.1	33.6±2.2		
Ht % post-operative (gm/dl)				
Range	25.5-35.5	26.04-35.98	0.98	0.211
Mean ± SD	30.9±2.3	31.0±2.5		
Paired t	1.22	1.03		
P	0.098	1.03		

T: Student t test, p: p value for comparing between the two groups.

Table 4: Comparison between the two studied groups regarding intra-op complaints and complications, (n=100).

Complaint	Group A		Group B		X^2	P
	No	%	No	%		
Nausea	44	44	23	23	9.65	0.001*
Vomiting	40	40	18	18	11.02	0.001*
Hypotension (decreased BP>20 mmHg of baseline)	11	11	9	9	1.23	0.365 N.S.
Tachycardia	24	24.0	3	3.0	18.52	0.001**
Uterine a-tony	6	6	4	4	0.421	0.516
Hematoma formation	4	4	5	5	0.116	0.733

P: p value for comparing between the two groups, p< 0.05 (there is statistical significant relation).

Table 5: Comparison between the two studied groups regarding number of vicryl stitch ampoules used, dose of analgesic (voltaren) by (mg), duration of uterine repair in minutes and the duration of the whole surgery, (n=100).

Groups variable	Group A		Group B		Test of sig.	P
	No	%	No	%		
Vicryl ampoule						
One	19	19.0	14	14.0		
Two	79	79.0	84	84.0	χ^2=0.911	0.634 N.S.
Three	2	2.0	2	2.0		
Dose of analgesic (Voltaren) by (mg)						
Range	140-310		150-300		t=1.68	0.077N.S.
Mean ± SD	231.4±54.8		221.2±46.1			
Duration of uterine repair (minutes)						
Range	3-8		5-10		t=4.25	0.001**
Mean ± SD	5.4±1.8		7.6±1.5			
Duration of surgery (minutes)						
Range	20-36		20-30		2.22	0.036*
Mean ± SD	27.3±5.0		25.6±3.1			

T: Student t-test, p: p value for comparing between the two groups.

Table 6: Comparison between the two studied groups regarding postoperative signs and symptoms and return of intestinal sounds, (n=100).

Signs and symptoms	Group A		Group B		Test of sig.	P
	No	%	No	%		
Nausea	46	46.0	30	30.0	χ^2=6.52	0.012*
Vomiting	27	27.0	20	20.0	χ^2=2.02	0.036*
Uterine a-tony	3	3.0	4	4.0	χ^2=0.52	0.48 N.S.
Return of intestinal sounds (hours)						
Range	10-20		5-15		t=6.21	0.001**
Mean ± SD	14.9±3.2		9.7±3.3			

T: Student t-test, p: p value for comparing between the two groups.

Table 7: Comparison between the two studied groups regarding the time of ambulation (hours) and postoperative fever, (n=100).

Variables	Group A		Group B		X²	P
	No	%	No	%		
Ambulation duration (Hours)						
<12	51	51.0	47	47.0	0.213	0.682
>12	49	49.0	53	53.0		
Post-operative fever						
Yes	5	5	7	7	0.168	0.725
No	95	95	93	93		

DISCUSSION

The ideal surgical technique for c-section continues to generate much debate in obstetric community.[15, 16]

A study conducted by Gode et al published in 2012 reviewed medical records from 1,087 patients with caesarean section with spinal anesthesia retrospectively, 732 patients had an in situ uterine repair, and 355 patients had an exterior uterine repair.

This study and a study done by Doganay et al revealed that in situ repair of uterus is a valuable technique for repair of uterine incision.[15,16] It is an easier and faster repair and offered shorter surgical time and shorter time to the first recognized bowl movement.[16]

On the other hand, exteriorization of the uterus is a common practice worldwide. In a meta-analysis done by Zaphratos et al published in August 2015, sixteen studies were included, about 9,736 subjects underwent exteriorization and 9,703 had *in-situ* uterine repair. Researchers found that exteriorization offers easier and faster repair due to better exposure of the angles decreasing the surgical time, thus decreasing intra-operative hemorrhage. They also claimed that elevation of the uterus promotes venous drainage and decreases vascular congestion there by decreasing bleeding and adverse outcomes as nausea, vomiting, pain and hemodynamic changes.[17]

In our study, no significant difference was found between both groups regarding blood loss matching with results found by Nasir et al in a randomized control trial published in 2011 in which 260 women underwent cesarean delivery, assigned to two groups; group A (exteriorization), group B (*in-situ*). Blood loss was not statistically significant (p=0.517).[18]

Nasir and colleagues recruited women with primary caesarean sections as well as previous caesarean sections and this could create confounding results unlike our study where only previous one caesarean delivery were selected.

Another meta-analysis done by Zapharatos et al published in August 2015 included sixteen studies where 9.736

women underwent exteriorization and 9,703 had *in-situ* uterine repair. Researchers found that pooled results from six studies (908 patients) for estimated blood loss showed no statistically significant difference between the two groups.[17]

Exteriorization theoretically might help in decreasing blood loss by kinking uterine arteries, more effective bimanual compression, better access to uterine incision and faster suturing and haemostasis. But, relatively bloodless field during exteriorization may be a false impression as blood flows away from the operating field, unlike the pooling and obscuring of operating field that occurs with in situ repair. This was the opinion of Orji et al in their study.[19]

Consistent with the findings reported in the current study, Ozbay et al also found no statistically significant difference in blood loss during surgery using preoperative and postoperative haematocrit values. Their study included 338 women randomized to two groups; exteriorization group (n=171) and (*in situ* repair group) (n=167).[20]

As regards intra-operative nausea and vomiting we noticed significant frequency in the exteriorization group than the *in-situ* group. This result matched with Shuja et al in a study which included 780 pregnant women (390 in each group). Exteriorization had been associated with more vomiting intra-operatively (18% with *in-situ* repair compared to 38% with exteriorization, p<0.001).[21]

Zafar et al published a study in August 2016 including 170 patients divided into 2 groups; 44.7% of cases in the exteriorization had nausea compared to 22.4% in the *in-situ* group (p=0.02). Vomiting occurred in 23.5% in exteriorization group compared to 11.8% in *in-situ* group (p=0.04).[22] These findings suggest strong association between occurrence of nausea/vomiting and uterine exteriorization. This was also reported by Zapharatos et al and Bushra et al patients in the exteriorization group exhibited nausea/vomiting immediately after exteriorization and then again at time of repositioning the uterus into the abdominal cavity.[17, 23]

However, these findings were not in conformity with the other literature reports which showed no statistically significant differences between exteriorization and in situ repair of uterus as regards nausea and vomiting like studies done by Gode et al and Ozbay et al.[15,20]

In the present study, *in-situ* uterine repair was associated with less intra-operative complications, nausea, vomiting, hypotension and tachycardia, all of them were statistically significant except for hypotension (p<0.05).

A significantly higher incidence of tachycardia and a non-significant increase in the incidence of hypotension, were observed among exteriorization group coinciding with repositioning of the uterus into the abdominal cavity which is a very intense stimulus explaining tachycardia.

Duration of uterine repair and surgery was significantly shorter with uterine exteriorization. Coutinho et al found a significant difference between the two techniques in an analysis which included 637 women, 312 patients had in situ uterine repair and 325 patients had exteriorized uterine repair. Time was shorter and sutures were fewer in number when the uterus was exteriorized.[24]

In a study by Zafar et al published in 2016; 170 women were divided into 2 groups; a significant difference was found in surgical duration being 36.38 min *in-situ* uterine repair group and 32.78 min in exteriorized group (p=0.0001).[20]

But in a study done by Shuja et al published in 2015 on 780 pregnant women (390 in each group); the operating time with in situ repair was less compared to exteriorization due to ease of repair and quick haemostasis, p=0.003).[21]

Number of vicryl ampoules used was not statistically significant but we noticed that we used a less total number of ampoules in the in-situ group than the exteriorized group, and this may become economically significant when applied to practice in hospitals. Extra ampoules were for haemostatic sutures after doing the 2 layers uterine incision closure in the exteriorized group which was rarely resorted to in the *in-situ* group. Concerning surgical procedure, we noticed that exposure of suture line and uterine angles were easier with uterine exteriorization, also dealing with hematomas was easier and faster but the need of doing haemostatic sutures after doing the 2 layers closure of the uterine incision was more in the exteriorized group and that's why some surgeons favored uterine exteriorization in a meta-analysis done by Zaphratos and others.[17] As regards uterine atony; we did not find a difference between the two groups.

Doganay et al did a randomized control study conducted at the delivery clinic of the Zekai Tahir Burak female health education and research hospital, Ankara, Turkey, where 4925 pregnant women were assigned to *in situ* uterine repair (group 1) or exteriorized uterine repair (group 2). The mean operation time was 36.8±4.2 minutes in

group1and44.6± 3.7 minutes in group 2 (p=0.001), intra-operative uterine atony developed in 96 cases in group 1 (3.8%) and 226 cases in group 2 (9.1%) with a p=0.001. The study suggested that in situ uterine repair is preferred to uterine exteriorization.[14]

Pain control after caesarean section is a real concern for all women, in our study, pain was assessed by doses of analgesics postoperatively which was not statistically significant between both groups.

In a meta-analysis done by Zaphratos et al overall pooled results from three studies (439 patients) did not show a statistically significant difference concerning pain between the two repair techniques, but, a randomized clinical study conducted by Shuja et al found lower pain scores within the in situ uterine repair group.[17,21]

In our study some cases reported postoperative febrile illness but it was not statistically significant. Oreiji et al had the same result in a randomized study on 210 pregnant women. Fever occurred in 38.1% in the *in-situ* group compared to 26.7% in the exteriorization group (p=0.77).[19]

But Shuja et al found that the *in-situ* group had thrice the febrile morbidity compared to the exteriorized group, which was statistically significant (p=0.005).[21]

In the present study, return of bowel function was significantly different between the two groups. The same results were demonstrated by Shuja et al the mean time for the first recognized bowl movement was 16.11±4.98 hours with uterine exteriorization and 13.10±3.45 hours with situ repair (p<0.001).[21]

Abdellah et al at a tertiary university hospital in December 2017 recruited 1028 women>37 weeks gestation scheduled for repeat caesarean section under spinal anesthesia, the time to the first recognized bowel movement was 12.3 hours with *in situ* repair versus 14.1 hours with exteriorization which was statistically significant (p=0.003).[25] Also, a meta-analysis done by Zaphratos et al revealed pooled results from four studies including 3,234 women, three of them strongly recommended in situ repair with statistically significant differences reported.[17]

Similarly, Doganay et al found that the mean time for the first detected bowel sound was 12.03±0.44 hours with situ repair and 15.93±0.52 hours with exteriorization (p=0.001).[14] Also, Abdellah et al in 2017 included 1028 women in a study. The time to the first recognized bowel movement was significantly lower in the in-situ group compared to the exteriorization group (12.3 hours vs 14.1 hours; p=0.003).[25]

CONCLUSION

There is no definite or absolute privilege of *in-situ* versus exteriorization, so there is no fixed protocol for caesarean section.

In either technique some data justify a choice, so surgical situation and personal preference for a determined technique are the main guide for the choice.

ACKNOWLEDGMENTS

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