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Original Article

The perioperative maternal outcomes of bilateral internal iliac artery ligation in morbidly adherent placenta previa

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Abstract

Objective

The aim was to detect the effects of bilateral internal iliac artery ligation (IIAL) either before or after placental separation on the intraoperative and postoperative maternal outcomes.

Background

Morbidly adherent placenta (MAP) is abnormal adherence of the placenta to the underlying uterine wall. It can cause significant adverse maternal consequences including the risk of severe intrapartum and/or postpartum bleeding, cesarean hysterectomy, intensive care unit admission, and prolonged hospitalization days. Early diagnosis of MAP helps optimal management with decrease of maternal and neonatal compromise. Uterine sparing can be attempted for patients seeking for fertility preservation. For those patients, several surgical hemostatic techniques including the prophylactic IIAL seemed to reduce blood supply to the pelvic organs and consequently, prevent life-threatening intraoperative blood loss and reduce transfusion requirements.

Participants and methods

The research is a randomized clinical trial that was conducted on 30 inpatient pregnant women – with inclusion and exclusion criteria – diagnosed by ultrasound to have placenta previa with MAP. The study population is divided into test and control groups according to the intervention of bilateral IIAL. The primary operative outcome was the direct blood loss assessment, the secondary outcomes were the indirect measures of blood loss (shock index, hemoglobin and hematocrite concentrations, and blood transfusion units), and the tertiary outcomes were the maternal mortality and morbidities and the operative and postoperative time variables.

Results

The prophylactic IIAL (group 1) significantly decreased the intraoperative time by approximately 48 min, the bleeding control time by 47%, operative blood loss by 40%, the number of transfusion units of packed red blood cells, and the shock index (a mean of 1.12). There were marked significant blood hemoglobin and hematocrit differences, with the highest mean in group 1 (8.66 g/dl and 28.3%, respectively). The postoperative results revealed decrease in the hospital stay time and the febrile period in prophylactic IIAL, with means difference of −1.7 and −2 days, respectively. The frequencies of emergency hysterectomy (2/30 cases), urinary tract injuries (1/30 case), and maternal mortality (1/30 case) were absolutely confined to the group without the intervention of IIAL (group B).

Conclusion

In placenta previa with MAP, the operative bilateral IAAL either before or after placental separation – but the superiority for prophylactic IAAL – decreased intrapartum and postpartum complications and minimized the risk of the emergent hysterectomy.

Keywords: Internal iliac artery, morbidly adherent placenta, placenta previa, surgical fertility preservation

Introduction

Placenta accreta or morbidly adherent placenta (MAP) is defined as direct attachment of the placental trophoplast to the myometrium of the uterus without intervening decidua [1]. The

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increased placenta accreta incidence over the next century is probably caused by the increased number of cesarean sections and maternal age at the time of delivery [2]. The most cited placenta accreta risk factors were placenta previa and a prior cesarean section history [3].

Placenta accreta becomes a delivery problem when the placenta does not separate from the uterus completely and is followed by severe obstetrical hemorrhage, leading to multiple medical and surgical complications, resulting in approximately 7% maternal mortality and morbidity up to 60% [4].

The best definitive management option in MAP is hysterectomy, but this represents a problem when patients desire to preserve the uterus and fertility potential; thus, alternative management options to minimize operative blood loss and decrease the need for cesarean hysterectomy have been proposed. One of which is the prophylactic bilateral internal iliac artery ligation (IIAL) before placental extraction to decrease intraoperative blood loss through pelvic circulation reduction, primarily owing to disruption of the arterial blood supply to the uterus while blood supply preservation to other pelvic structures [5]. This operative technique is assumed to be an effective procedure to decrease the major complications and participate in lowering the rate of intrapartum hysterectomy [6].

Participants and methods

This research is a randomized clinical trial, both prospective and retrospective. The randomized study was conducted at the Obstetrics and Gynecology Department, Shebin Elkom Teaching Hospital, between February 2016 and April 2018.

The local hospital ethical rules of human medical research were followed. All patients were counseled about the research intervention management options and the possible complications, including the need for blood transfusion and emergency hysterectomy to stop massive bleeding, and a written informed consent was obtained.

The study population included 30 pregnant women chosen randomly with computer-assisted randomization from those admitted to the hospital with placenta previa accreta diagnosed by ultrasonography (TVS and color Doppler). The sonographic diagnostic criteria of MAP include loss of retroplacental hypoechoic space, thinning or disruption of the hyperechoic interface between bladder and uterine serosa, diffuse placental lacunae (Swiss cheese appearance), and color Doppler abnormal hypervascularity of uterine serosa-bladder interface with turbulent flow [7].

The inclusion criteria included preoperative diagnosis of placenta previa accreta, gestational age 28 weeks or more, and previous cesarean delivery. The exclusion criteria included nonprevious cesarean deliveries, gestational age less than 28 weeks, pregnancy with multiple fetuses, and pregnancy complicated by medical disorders such as hypertension, diabetes mellitus, or coagulopathy.

Cesarean deliveries were planned at 37 weeks of gestation unless there were other obstetrical conditions.

The population study was classified according to the intraoperative intervention of IIAL into the following:

Test group (group A) was represented by 20 patients who had planned for the operative intervention procedure of IIAL.

This test group is subclassified into two groups:

(1) Group 1: it consisted of 10 patients who had IIAL before placental separation
(2) Group 2: it consisted of 10 patients who had IIAL after placental separation.

Control group (group B or group 3): it was represented by 10 patients who did not have the operative intervention procedure of IIAL during their operative deliveries. The control group was selected retrospectively via the hospital medical records to avoid the cross-over, bias errors, and guarantee for patient safety.

Routine evaluation for all patients was carried out according to the department policy by assessment of history, clinical examination, and investigations, including complete blood count, coagulation profile, and organ functions.

A multidisciplinary team including a senior obstetrician and assistant, an anesthesiologist, a urologistm and a vascular surgeon were involved in the delivery operation. Cross-matched blood was prepared [at least four units of packed red blood cells (RBCs)] for each patient. Surgical planning regarding incisional site and avoiding incising the placenta were cautioned. After extraction of the fetus, the uterus with the placenta inside was exteriorized outside the incision, and the anterior division of the internal iliac artery was ligated on both the sides in the test groups. The intervention of the IIAL was done through adequate exposure obtained by opening the posterior peritoneum over the bifurcation of the common iliac arteries, and IIAL was performed 3–4 cm distal to this level to avoid the posterior division of the artery. A right-angle clamp was passed carefully just beneath the artery from lateral to medial. With the clamp aid, silk suture was passed under the artery and the vessel was then double ligated.

In the control group, alternative hemostatic procedures were performed as bilateral uterine and ovarian artery ligation, multiple square hemostatic sutures, and/or placental bed sutures.

The primary outcome measure was the amount of intraoperative blood loss (assessed by the sum of the volume at suctioned bottles plus the calculated Gauze visual analog models for blood loss estimation) [8] (Fig. 1).

The secondary outcomes (indirect measures of blood loss) were the shock index (heart rate/systolic arterial blood pressure [9]), the number of blood transfusion units, and postoperative hemoglobin and hematocrit concentrations.

The tertiary outcomes were the operative time, the bleeding control time after placental separation, the operative maternal

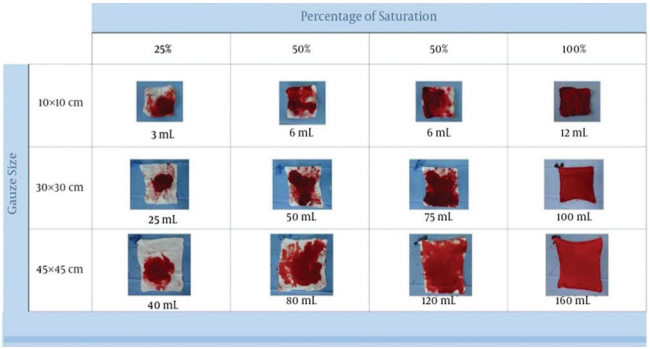

Figure 1: Blood loss estimation using Gauze visual analog.

morbidities (the need for emergency cesarean hysterectomy, the urinary tract injuries), the postoperative maternal morbidities (the need for ICU transfer, and postoperative stay and febrile times), and the maternal mortality.

Statistical analysis

IBM SPSS statistics software package version 20 (SPSS Inc., Chicago, Illinois, USA) was used for data analysis. Date were expressed as mean ± SD for quantitative parametric measures, whereas frequency and percentiles for qualitative data.

The following statistical tests were used: the Student '*t*' test for comparison of means of quantitative variables of two independent groups in normally distributed data, whereas one-way analysis of variance test for more than two groups. χ^2-test and Fisher exact test were used to calculate difference between qualitative variables.

The probability of error less than 0.05 was considered significant, whereas *P* less than 0.001 is highly significant.

Results

The age of the study patients was on an average ~31 years (Table 1).

The operative criteria (operative time, operative blood loss and transfusion units of packed RBCs) as influenced by the frequency of the previous section deliveries showed insignificant differences regarding the operative time, whereas significant difference regarding the operative blood loss and transfusion units of packed RBC (Table 2).

The operative parameter (operation time and control bleeding time) differences between the comparable study groups revealed high significant operating time difference between study groups interchangeably, whereas the bleeding control time difference was only highly significant between group 1 and either groups 2 or 3, interchangeably (Table 3).

The differences of the operative parameters of blood loss assessment revealed the following (Table 4):

(1) Significant operative blood loss difference between group 1 and either groups 2 or 3 interchangeably.
(2) High significant blood hemoglobin and hematocrite differences between group 1 and group 3, significant hemoglobin difference between group 2 and group 3, and significant hematocrite difference between group 2 and either groups 1 or 3 interchangeably.
(3) High significant shock index difference between group 1 and either group 3 or group 2 interchangeably, and significant difference between group 2 and group 3.
(4) Significant transfusion units of packed RBCs difference only between group 1 and group 3.

The description of the postoperative care variables shows shortest hospital stay time and postoperative febrile period in group 1 (6.60 ± 1.58 and 5.50 ± 0.71 days, respectively) and the longest in group 3 (8.30 ± 1.70 and 7.50 ± 1.90 days, respectively) (Table 5).

The analysis of the variation of the postoperative care parameters pointed only significant hospital stay time differences ($P < 0.05$) between group 1 and either groups 2 or 3 interchangeably. The

Table 1: The age characteristics of the study patients

	n	Minimum	Maximum	Mean	SD
Age	30	22.00	41.00	31.30	4.00

Table 2: The analysis of variation of the operative criteria (operative time and operative blood loss and the transfusion units of packed red blood cells) as influenced by the frequency of the previous section deliveries

	Previous CS	Mean±SD	Test (ANOVA)	*P*
Operating time	1.00	99.86±27.50	*F*=2.15	>0.05
	2.00	97.44±16.07		
	3.00	115.17±21.84		
	4.00	138.00		
Intraoperative blood loss	1.00	1992.86±594.07	*F*=3.79	<0.05
	2.00	2153.75±725.64		
	3.00	2396.67±927.38		
	4.00	4600.00		
Transfusion units of packed RBCs	1.00	3.86±0.69	*F*=6.27	<0.05
	2.00	3.56±1.03		
	3.00	3.83±1.17		
	4.00	8.00		

ANOVA, analysis of variance; CS, cesarean section; RBC, red blood cell.

Table 3: The analysis of relative difference of the operative parameters (operation time and control bleeding time) between the comparable study groups

	Compare groups		*t*	*P*
Operating time	Group 3	Group 1	−12.15	<0.001
		Group 2	−6.45	<0.001
	Group 1		−6.80	<0.001
Time to control bleeding after placental separation	Group 3	Group 1	−6.66	<0.001
		Group 2	−1.62	>0.05
	Group 1		−4.62	<0.001

postoperative febrile period variable revealed high significant difference ($P < 0.001$) between groups 1 and 3 and significant difference ($P < 0.05$) between groups 2 and 3 (Table 6).

The frequency description and analysis of the morbidity and mortality variables were absolutely confined to the group B, but significant difference was only confined to the emergency hysterectomy. The morbidity and mortality in our study were broadly confined to the study group B with higher frequency significant difference as regards the need for intra-operative emergency hysterectomy. In addition, significant difference ($P < 0.05$) was obtained with higher frequency of ICU transfer in group B than group A (Table 7).

The frequency distribution of the previous cesarean section deliveries revealed seven (23%), 16 (53%), six (20%), and one (4%) corresponding to previous cesarean deliveries 1, 2, 3, and 4, respectively, with most cases confined to the previous two categories and the minority to the previous fourth category (Fig. 2).

The description of variation in the operative parameters such as the operative times showed mean ± SD of 80.30 ± 6.36, 100.20 ± 7.39, and 128.20 ± 10.73 min and bleeding control times showed mean ± SD of 18.70 ± 5.19, 30.40 ± 6.11, 34.60 ± 5.48 min relative to study groups 1, 2, and 3, respectively (Fig. 3).

The description of measurable operative blood loss assessment among the population study groups showed higher blood loss mean ± SD of 2724 ± 886 ml in group 3 relative to 1643 ± 453 ml in group 1 (Fig. 4).

The description of variations of the blood hemoglobin concentration and the hematocrite value between study groups with higher hemoglobin and hematocrite (8.66 ± 0.42 g/dl and 28.30 ± 2.31%, respectively) in group 1 and the lower values (7.85 ± 0.64 g/dl and 21.10 ± 3.03% respectively) (Fig. 5).

The description of variations of the shock index and the transfusion units of packed RBCs between the study groups showed the lowest shock index and highest transfusion units of packed RBCs (1.12 ± 0.10 and 3.20 ± 0.92 units, respectively) in group 1 and the highest shock index and lowest transfusion units of packed RBCs (1.48 ± 0.10 and 4.60 ± 1.51 units, respectively) in group 3 (Fig. 6).

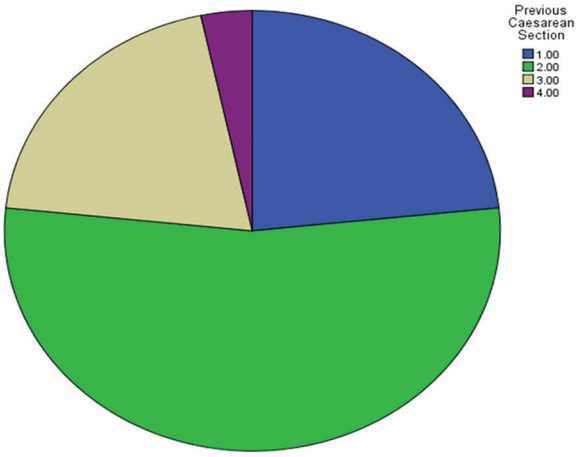

Figure 2: The frequency distribution of the previous cesarean section deliveries in the study population.

Discussion

The age of the study population had a range of 22–41 years, with an average of ~31 years (Table 1). The majority of them had a history of previous two section deliveries (53%), and only one case had previous four section deliveries (4%) (Fig. 2). These findings go parallel with the report of Evsen *et al.* [10] that placenta

Table 4: The analysis of differences of the operative parameters of blood loss assessment between the comparable study groups

	Compare groups		*t*	*P*
Intraoperative blood loss	Group 3	Group 1	−3.44	<0.05
		Group 2	−0.94	>0.05
	Group 1		−2.54	<0.05
Blood hemoglobin concentration	Group 3	Group 1	3.34	<0.05
		Group 2	1.25	>0.05
	Group 1		2.57	<0.05
Hematocrit (%)	Group 3	Group 1	5.97	<0.001
		Group 2	2.39	<0.05
	Group 1		2.19	<0.05
Shock index	Group 3	Group 1	−7.81	<0.001
		Group 2	−2.22	<0.05
	Group 1		−4.33	<0.001
Transfusion units of packed RBCs	Group 3	Group 1	−2.51	<0.05
		Group 2	−1.66	>0.05
	Group 1		−1.28	>0.05

RBC, red blood cell.

Table 5: The description of the variables of postoperative care among the study groups

	Study groups	Mean	SD
The hospital stay time (days)	Group 1	6.60	1.58
	Group 2	6.80	1.23
	Group 3	8.30	1.70
The postoperative febrile period (days)	Group 1	5.50	0.71
	Group 2	6.50	0.85
	Group 3	7.50	1.90

Table 6: The analysis of the variation of the postoperative care parameters in the comparable study groups

	Compare groups		*t*	*P*
The hospital stay time (days)	Group 3	Group 1	−2.32	<0.05
		Group 2	−2.26	<0.05
	Group 1		−0.31	>0.05
The postoperative febrile period (days)	Group 3	Group 1	−12.15	<0.001
		Group 2	−1.52	>0.05
	Group 1		−2.86	<0.05

Table 7: The frequency description and analysis of the morbidity and mortality complication variables among the study groups according to the intervention procedure, internal iliac artery ligation

	Groups according to IIA ligation		Total	Test	*P*
	Group A	Group B			
The emergency need for hysterectomy [*n* (%)]					
Absent	20 (71)	8 (29)	28 (100)	Fisher exact test: 4.69	<0.05
Present	0	2 (100)	2 (100)		
The operative urinary tract injuries [*n* (%)]					
Absent	19 (95)	1 (5)	20 (100)	Fisher exact test: 0.25	>0.05
Present	9 (90)	1 (10)	10 (100)		
The need for ICU transfer [*n* (%)]					
Absent	18 (90)	2 (10)	20 (100)	Fisher exact test: 8.33	<0.05
Present	4 (40)	6 (60)	10 (100)		
Maternal mortality [*n* (%)]					
Absent	20 (100)	0 (0)	20 (100)	Fisher exact test: 2.27	>0.05
Present	9 (90)	1 (10)	10 (100)		

IIA, internal iliac artery.

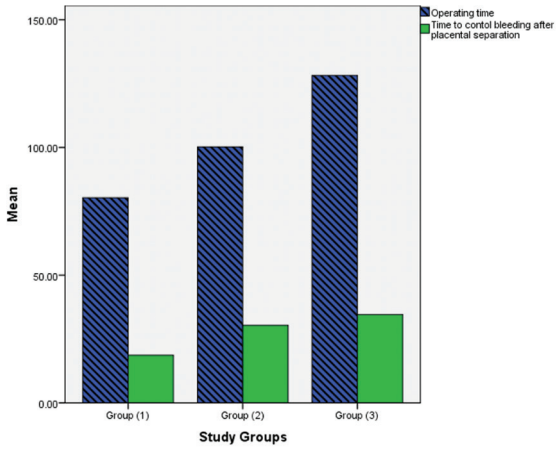

Figure 3: The description of the operative parameters (operative time and bleeding control time) relative to study groups.

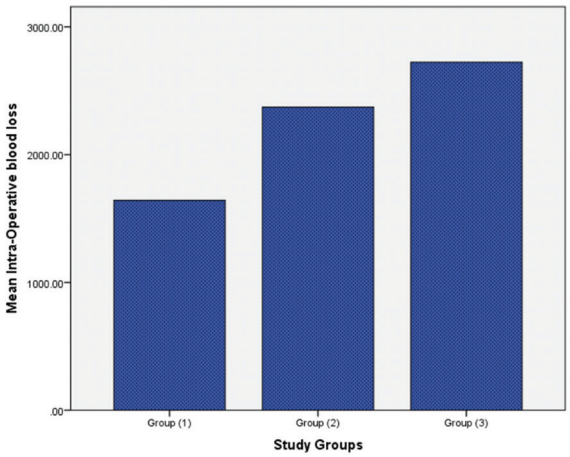

Figure 4: The description of measurable operative blood loss assessment among the population study groups.

accreta is highly associated with the existence of placenta previa, especially in cases with previous cesarean delivery.

Insignificant operative time differences ($P > 0.05$) were obtained in relation to the order of section deliveries (Table 2), whereas significant differences were observed regarding the operative blood loss and transfusion units of packed RBCs, with increasing blood loss and the amount of the transfused units with increasing order of previous section deliveries (Table 2). These observations were comparable to Doherty *et al.* [11], where the operative time is lengthened by age greater than 35 years, BMI greater than 30, prior cesarean delivery, uterine incision, surgeon inexperience, and with an increased blood loss.

The differences of our research operative time parameters between the comparable research groups demonstrated high significant difference of the operating time between the individual groups, with a reduction of about 48 min if the IIAL was done before placental separation (group 1), relative to 28 min if it is done after (group 2) (Fig. 2). Moreover, the time for bleeding control difference was reduced markedly in group 1 (47% reduction) (Fig. 3) and to a lesser reduction (11%) in group 2, whereas no significant difference was observed between groups 2 and 3 (Table 3). This was in accordance with what was reported by Hansch *et al.* [12] that a major benefit of IIAL over other occlusion interventions is the operative time save and decreased operative complications.

Controversially, some authors [13] reported that, in cases of MAP, IIAL did not significantly improve hemostasis during cesarean hysterectomy.

Our results regarding the operative parameters of blood loss (Table 4) revealed the following: significant operative blood loss decrease was encountered in group 1 relative to groups 2 or 3 interchangeably (a mean of 1643, 2372, or 2724 ml, respectively) (Fig. 4), whereas lack of significant blood loss difference ($P > 0.05$) between groups 2 and 3. Moreover, an obvious decrease of the number of the packed

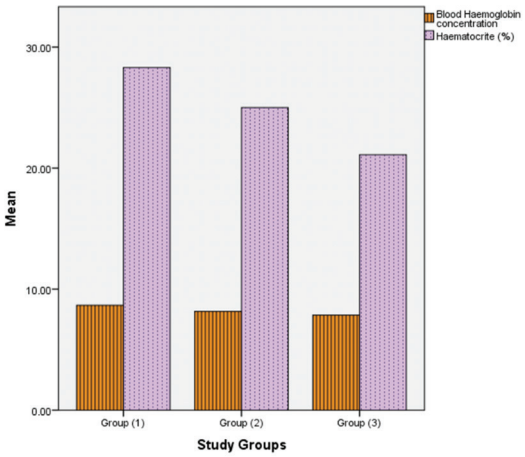

Figure 5: The description of variations of the blood hemoglobin concentration and the hematocrite value (as indirect parameters of the operative blood loss) as related to the study groups.

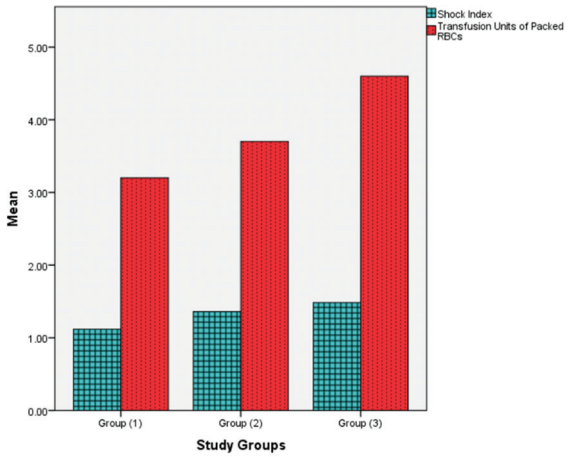

Figure 6: The description of variations of the shock index and the transfusion units of packed red blood cells (as indirect parameters of the operative blood loss) as confined to study groups.

RBCs transfused units ($P < 0.05$) only if IIAL was done before placental separation than if it was done afterwards or not done (3.2 vs. 3.7 and 4.6 units, respectively) (Fig. 6). These results were ascertained by Refaie *et al.* [6], emphasizing that prophylactic bilateral IIAL before extraction of placenta accreta was an effective method to decrease cesarean section blood loss, blood transfusion, and complications.

There were marked significant blood hemoglobin differences between group 1 and either group 2 or 3, with the highest mean in group 1 (8.66 g/dl) and the lowest in group 3 (7.85 g/dl) (Fig. 5), whereas a lack of significant difference ($P > 0.05$) between group 2 and group 3. Additionally, marked hematocrit differences were observed between group 1 and group 3, and significant difference between group 2 and either groups 1 or 3 interchangeably, with mean values being highest in group 1 (28.3%) and lowest in group 3 (21.1%) (Fig. 5). These changes were also reported by Warda [14] with a hemoglobin level of 9.24 ± 1.79 g/dl and a hematocrit of 24.2 ± 5.1% after 1 day postoperative of cesarean section at which IIAL was done for placenta previa.

There were marked significant shock index differences between group 1 and either group 3 or group 2 interchangeably, and significant difference between group 2 and group 3, with means values being lowest (1.12) in group 1 and highest (1.48) in group 3 (Fig. 6). This was also similar with the approximate results of another research report [9].

The postoperative outcome of our results revealed a decrease of the hospital stay time and the postoperative febrile period in group 1 compared with group 3 (mean differences of −1.7 and −2 days, respectively) (Table 5), whereas significant differences were observed between group 1 and either groups 2 or 3 interchangeably; however, no significant difference ($P > 0.05$) was present between group 2 and group 3 (Table 6). These observations are in agreement with the statement of El-Sayed [15] with respect to the postoperative febrile period but not the hospital stay time.

The frequency description and analysis of the morbidity and mortality in the current research revealed the emergency need for hysterectomy (two cases), urinary tract injuries (one case) and maternal mortality (one case) were absolutely confined to the group without the intervention of IIAL (group B), but significant analyses were present only in the emergency need for hysterectomy (Table 7). This significant decrease of emergency hysterectomy after IIAL was confirmed by some authors [16] but disapproved by others [17] who reported no significant differences. In addition, significant difference was obtained with higher frequency of ICU transfer in group B than group A (60 vs. 40%, respectively). This was ascertained by the findings that preoperative diagnosis of placenta praevia accreta, the presence of a multidisciplinary experienced team, and IIAL may decrease maternal serious morbidity and mortality [18].

Limitations

The direct operative blood loss was suspected to be under-estimated as the soaked gowns and drapes were not measured, so indirect measures (shock index, hemoglobin and hematocrite concentrations and blood transfusion units) were used to overcome this problem.

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Conflicts of interest

There are no conflicts of interest.

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