

## Residents Experience and Blood Loss in Primary Cesarean Sections

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### Abstract

**Objective:** Compare the Estimated Blood Loss (EBL) between residents performing primary cesarean sections based on their level of training and their associated variables, including the combination of surgeon and assistant experience, demographic variables and different techniques in the procedure.

**Methods:** Retrospective analysis of patients who had a primary cesarean section performed by residents from the Obstetrics and Gynecology Residency Program that attended the Labor and Delivery between August 2011 through December of 2012. 278 patients were included. Demographic and pertinent data was extracted from patient's electronic medical record. The surgeons and assistants were categorized depending on their level of training in the residency program (Post Graduate Year [PGY]1,2,3,4).

**Results:** 278 patients were included in the study, of them 133 were considered emergent cesarean sections mean cEBL of  $832 \pm 490$ , 74 urgent with  $829 \pm 513$  cc, 67 scheduled with  $884 \pm 167$  cc and 4 elective with  $825 \pm 52$  cc with an observed Estimated Blood Loss (oEBL) of  $873 \text{cc} \pm 182$ , change in hematocrit of  $5.14 \pm 3.13$  and a calculated (cEBL) of  $832.5 \pm 490$  cc. time in minutes was different between 1 and 2 layers closure (57.4 vs. 67.7 minutes) and their cEBL 734 vs. 662cc.

**Conclusions:** There is a difference in cEBL and change in hematocrit in primary cesarean sections done by residents based on their surgical experience. Time, cEBL, change in Hto is influenced by the years of training of the surgical team. Higher BMI was associated with more surgical time and change in Hto. 2 layer closures were found to consume more surgical time.

**Keywords:** Cesarean sections; Estimated blood loss; Change in hematocrit; Residents

### Introduction

Cesarean Section is the most common surgical procedure in the United States with continuously increasing incidence [1]. As per any surgical procedure preoperative, postoperative and perioperative precautions must be taken. There is no standard technique for Cesarean section. Prompt recognition and proper management of complications together with an experienced surgical team leads to minimizing those risks, including blood loss [2].

Major hemorrhage continues to be one of the most common causes of direct maternal death in obstetric practice [3].

The error in estimating blood loss is higher if measured loss exceeds 600 ml by the obstetrician. Clinicians routinely estimate blood loss using visual assessments. However overestimation of small volumes and underestimation of large blood volumes are clinically significant. As mentioned by Toledo et al. the level of training improved the estimation accuracy of blood loss [4,5].

Many factors would be implicated to affect intra-operative blood loss during CS e.g. maternal causes; weight, parity, previous CS, fetal causes; multiple gestation, lack of prenatal care, polyhydramnios, malpresentation, technical causes; operative time, type of incision, placental separation technique, placental position, abnormal placentation (previa, increta, percreta, accreta) and the type of anesthesia [6].

Calculated estimated blood loss (cEBL) is an equation used to objectively estimate the blood loss of patients during surgery. It is derived by multiplying the calculated maternal blood volume by the percentage of blood volume lost, where calculated maternal blood volume =  $0.75 \times \{[\text{maternal height in inches} \times 50] + [\text{maternal weight in pounds} \times 25]\} / 10$  and percent of blood volume lost =  $\{(\text{predelivery HCT} - \text{postdelivery HCT}) / \text{predelivery HCT}\}$  [7].

Emergent cesarean sections have been defined as immediate threat to life of woman or fetus and urgent when maternal or fetal compromise

which is not immediately life-threatening, scheduled when early delivery is needed but no maternal or fetal compromise and elective at a time to suit the woman and maternity team [8].

The main objective of this study is to compare the blood loss between residents in their different levels of post-graduate training that performed primary cesarean sections and their associated variables. Between these variables we will take in consideration the patient physical characteristics, the different surgical techniques in the process and the combination of the level of experience of the surgical assistant by combining the surgical team, and the urgency of the case.

### Methods and Materials

This was a retrospective analysis of patients who had a primary cesarean section performed by residents from the Obstetrics and Gynecology Residency Program that attended the Labor and Delivery unit between August 2011 through December of 2012.

Demographic variables such as maternal age, height, weight, body mass index, fetal weight, gestational age were taken. Only patients with primary cesarean sections, singleton pregnancies, that had regional (epidural, spinal, or combined) anesthesia, and underwent a lower transverse uterine incision without previous surgeries, abnormal placentation, clotting deficiencies, that had a hemoglobin and hematocrit

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previous to the procedure and within 24 hours (post operative day 1) after the procedure were taken in consideration. 5 patients that received blood transfusion were not taken in consideration.

The study was approved by the Institutional Review Board no written consent was needed.

During the study 278 patients were included that meet the criteria. Demographic and pertinent data was extracted from patient's electronic medical record. The surgeons and assistants were categorized depending on their level of training in the residency program (Post Graduate Year [PGY] 1,2,3,4). The years of experience of the surgical team were extracted by combining the surgeon and assistant years of training. Estimated Blood loss was calculated from the cEBL formula,

	Average	Standard deviation
Age (years)	27.2	6.9
GA (days)	272.5	17.7
Height (meters)	1.6	0.07
Weight (Kg)	174.1	47.9
BMI	30.4	7.5
Birthweight ( grams)	3194.4	695.3
OEBL (cc)	873.9	182.3
Hto preop	33.9	3.1
Hto postop	28.8	3.7
change hto	5.1	3.1
CEBL in cc	832.5	490.8

oEBL observed Estimated Blood Loss  
Hto hematocrit

**Table 1:** Patients and Procedure Characteristics.

Surgeon	number of patients	cEBL (cc)	Standard deviation	P value	change Hto	standard deviation	P value	Time (minutes)	Standard deviation	P value
PGY 1	35	914.881	605.897	0.01	6.17857	4.2	0.03	66	14	0.1
PGY 2	85	840.814	555.984	0.04	5.01765	3.4	0.1	65	19	<0.001
PGY 3	43	857.158	389.439	0.2	5.51176	2.8	0.1	67	31	<0.001
PGY 4	115	781.912	454.767	0.1	4.71087	2.7	0.1	57	18	0.002

PGY post graduate year  
Hto hematocrit  
cEBL calculated Estimated Blood Loss

**Table 2.** Hto change, cEBL, and time between residents.

BMI	number of patients	Change Hto	Standard Deviation	P value	CEBL (cc)	Standard Deviation	P value	Time (min)	Standard Deviation	P value
<30	150	5.4	3.1	0.4	764	427	0.09	55	16	0.1
30-40	93	5.3	3.3	0.54	810	448	0.12	65	21	<0.001
41>50	35	3.7	2.5	0.66	890	549	0.13	66	25	<0.001

Hto hematocrit  
cEBL calculated Estimated Blood Loss  
BMI Body Mass Index

**Table 3:** Difference in BMI and change in Hto, cEBL, and time.

Exp. surgical team	Number of patients	CEBL (cc)	Standard Deviation	Change Hto	Standard Deviation	Time( minutes)	Standard Deviation
4 years	15	810	514	4.64	3.23	68.5	32
5 years	48	738	524	4.68	3.78	65.5	19
6 years	120	867	475	5.35	2.99	61.1	17
7 years	50	804	615	4.84	3.56	67.1	33
8 years	45	888	244	6.18	2.34	60.7	19
ANOVA		<0.001		0.01		0.472	

Hto hematocrit  
cEBL calculated Estimated Blood Loss

**Table 4.** Difference between combined years of experience in surgical teams (surgeon and assistant) and their cEBL, change in Hto and time.

the observed EBL (oEBL) was extracted from the operative note dictated by any of the members of the surgical team. All patients received an active management after the delivery of the fetus by administering 10 units IV of oxytocin as per hospital protocol.

Descriptive statistics were used to examine maternal age, weight, height, BMI, birth weight, gestational age and EBL. The statistical analysis was performed using Excel for Windows with SPSS package (version 18; SPSS Inc, Chicago, IL). Discrete data were analyzed with analysis of variance test (ANOVA) while continuous variables were analyzed with unpaired Student t- test. P<0.05 was considered significant throughout.

## Results

278 patients were included in the study, of them 133 were considered emergent cesarean sections mean cEBL of 832 ± 490, 74 urgent with 829 ± 513 cc, 67 scheduled with 884±167cc and 4 elective with 825 ± 52cc (p value=0.861).

Table 1 shows the patients characteristics, age, days of pregnancy, oEBL, change in hematocrit, and cEBL. In Table 2 patients were subdivided in 4 groups based on their post graduate year (PGY) of training of the resident performing the cesarean section, Table 3 shows the difference in groups according to their BMI, subcategorized in less than 30, 30-40 and more than 41 and their respective hematocrit change, cEBL, and time in minutes. Table 4 shows the cEBL, change in Hto, and time of cesarean sections based on the surgical team combined experience (surgeon years of training plus assistant years of training). As shown in Table 5 the time in minutes was different between 1 and 2 layers closure of the uterus and their cEBL cc734 vs. 662).

Uterine layers	CEBL(cc)	Standard Deviation	Change % Hto	Standard Deviation	Surgical time(minutes)	Standard Deviation	Number
1	734.8	658	4.33	3.16	57.4	15.9	116
2	662	499	4.13	3.21	67.7	22.9	162

cEBL calculated Estimated Blood Loss  
Hto Hematocrit

**Table 5.** Difference in 1 layer closure vs. 2 layers uterine closure.

## Discussion

cEBL was 832 cc vs. oEBL of 873 cc both falling within the limits of an expected blood loss. As Mention by Toledo et al. the level of training can affect the accuracy of the estimated blood loss. The presence of a formal training in blood loss estimation was a significant factor, in our residency program formal blood loss estimation is part of the curriculum training and could impacted our results [4].

When comparing the residents and their cEBL we find a difference between senior residents PGY3 and PGY4 vs. junior residents PGY1 and PGY 2 (p=0.01 and 0.47 respectively). In the change in hematocrit only the PGY 1 was significantly different  $6.2\% \pm 4.2$  with a (p=0.03). The time in minutes of the procedure, was significant different within the groups (p =<0.001) with a decreasing time as more experienced surgeon. This findings are compatible with have been classically described by many authors. As more experienced the surgeon and the assistant fewer the complications. As described by Hadar et al. [9] the odds ratio of complications is increased in cesarean sections done by residents.

By comparing the blood loss between the different characters of the cesarean sections, we did not find any statistically blood loss difference between emergent, urgent, elective and schedule cesarean sections.

There was a difference in hematocrit change based on the patients BMI. No difference was found in the cEBL. The time in the procedure was longer as the higher BMI group as described by Myles. BMI is an independent factor for the duration of cesarean section [10].

By combining Surgeon and Assistant experience was as seen in Table 4 the cEBL was significantly different within the groups (p=0.001), with more experience a lower cEBL. The change in Hto was significantly different (p=0.01) however the time in minutes within the groups was not (p=0.472).

To clarify the difference in techniques in cesarean section we sub categorize as shown in Table 5 based on the closure of the uterus in 1 or 2 layers. We found a difference in the surgical time) consistent with previous findings by other authors. cEBL and change in Hto was not significant within the groups.

## Limitations

The time the hematocrit was extracted from the patients while being in the 24 hours range (post-operative day 1), was not standardized. The residents were directly supervised by an Attending physician that can alter the technique and surgical time. The skin closure was not taken in consideration and can directly impact the surgical time.

## Conclusions

There is a difference in blood loss and surgical time primary cesarean sections done by residents and surgical team experience. BMI was associated with increase in surgical time and blood loss. 2 layer closures were found to consume more surgical time.

## Key Message

In primary cesarean sections the Surgeons experience was not found to have a direct impact in the cEBL and change in hematocrit. It is the surgical team experience that directly impact in the outcome of the surgery.

## Disclosure

The authors declare that there is no conflict of interests regarding the publication of this article.

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