Risk Factors for Perioperative Blood Transfusion in Patients Undergoing Hysterectomy for Benign Disease in a Teaching Institution

Michael Saad-Naguib (✉ miken412@gmail.com)

University of Miami Miller School of Medicine: University of Miami School of Medicine

<https://orcid.org/0000-0002-6676-6223>

Ashley Ulker

University of Miami Miller School of Medicine

Douglas Timmons

University of Miami Miller School of Medicine

Mary Grady

University of Miami Miller School of Medicine

Madeline Lederer

University of Miami Miller School of Medicine

Jose Carugno

University of Miami Miller School of Medicine <https://orcid.org/0000-0002-5716-4933>

Research Article

Keywords: Blood transfusion, hysterectomy, risk factors, laparotomy

Posted Date: April 29th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-356269/v1>

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Version of Record: A version of this preprint was published at Archives of Gynecology and Obstetrics on September 10th, 2021. See the published version at <https://doi.org/10.1007/s00404-021-06223-3>.

Abstract

Purpose: The purpose is to identify risk factors for perioperative blood transfusion in patients undergoing hysterectomy for benign disease.

Methods: This study is a retrospective chart review including all the patients who underwent hysterectomy for benign disease between January 1st 2018 and December 31st 2019. Patients who received perioperative blood transfusion were identified and compared to those who did not. The following risk factors for blood transfusion were analyzed: route of hysterectomy, BMI, presence of adhesions, history of cesarean section, uterine weight. Descriptive statistics was used to analyze the data.

Results: A total of 517 patients were identified and included in the study. Forty-seven patients (9.09 %) received a perioperative blood transfusion. The abdominal hysterectomy route (TAH) was a significant risk factor for receiving blood transfusion ($p=0.012$). Other identified risk factors for blood transfusion included: Body mass index above 33.0 ($p=0.002$), and uterine weight ($p=0.002$). There was no association between the presence of pelvic adhesions ($p=0.91$) or a personal history of cesarean section ($p=0.89$) and receiving perioperative blood transfusion. When analyzing only the patients who underwent TLH, the presence of pelvic adhesion was found as a risk factor for perioperative blood transfusion ($p=0.024$)

Conclusion: The abdominal hysterectomy route, the presence of a large uterus, and obesity are risk factors for receiving a blood transfusion. Early identification of the patient at risk of requiring perioperative blood transfusion provides better patient counseling and surgical preparation.

Introduction

In the United States, hysterectomy is one of the most common surgeries performed in gynecology [1]. As per the Centers for Disease Control and Prevention (CDC), approximately 600,000 hysterectomies are done each year, and by the age of 60, more than 1/3 of all women have undergone a hysterectomy [2]. Hysterectomy is a relatively safe procedure regardless of the selected surgical route [3]. While safe, hysterectomies, like other surgical procedures, carry the risk of blood transfusion, and these risks depend on several factors. It is important to identify these prior to surgery as perioperative blood transfusions should, when possible, be avoided. Despite the safeguards in place today, blood transfusions are not without risks such as acute transfusion reactions, medical errors, viral, and bacterial infections among others [4].

Researchers have examined the risk factors for transfusion following hysterectomy for benign indications. Several studies have demonstrated a low pre-operative hemoglobin and hematocrit to be a risk factor for blood transfusion [3]. A retrospective study in 2012 of 441 hysterectomies, 137 of which received a transfusion, concluded that a low preoperative hematocrit was associated with the need for perioperative transfusion, more so when the hematocrit is less than 30% [3]. Another study examining

1208 women found that large uterine size, higher estimated blood loss (EBL) during the procedure, and increased operative time were associated with receiving a blood transfusion [5]. This, however, appears to have some contradictory evidence. In a cohort of 263 patients, age of the patient, type of hysterectomy, duration of surgery and uterine weight were not associated with an increased risk of blood transfusion [6]. Hillis et al. demonstrated that women undergoing hysterectomy with a uterus weighing more than 500 g were 1.6 times more likely to develop operative or postoperative complications, specifically cuff cellulitis and the need for blood transfusion [3].

The goal of our study was to identify risk factors for perioperative blood transfusion in patients undergoing hysterectomy for benign disease in our teaching institution.

Materials And Methods

This study was approved by the institutional review board. Using electronic medical records, a systematic query was made regarding all types of hysterectomies for benign disease performed at our institution from January 1st, 2018 to December 31st, 2019.

Electronic medical records for each patient were accessed to obtain the following data: age, race, body mass index (BMI), history of c-section, history of vaginal deliveries, pre-op hemoglobin; surgical indication, route of hysterectomy (laparotomy, vaginal or laparoscopic), surgical operative reports, presence of adhesions, estimated blood loss (EBL), and pathology report for final diagnosis and uterine weight. Patients with gynecologic cancer diagnosis were excluded from this study.

Estimated blood loss was compared between routes of hysterectomy. In addition, we examined the following factors to determine their association with the need for blood transfusion: BMI > 30, presence of adhesions (bowel, omental or both), uterine weight, history of cesarean section, and pre-operative hemoglobin. The decision to transfuse patients intraoperatively was at the discretion of the attending surgeon and was based on the individual case and the estimated intraoperative blood loss.

Data was stored in a password protected online database. Descriptive statistics were used to analyze the data. A P-value of less than 0.05 was considered statistically significant.

Results

A total of 517 cases were identified and included in the analysis. Table 1 outlines the demographic information of the patients, including body mass index (BMI) and pre-operative hemoglobin. Forty-seven patients (9.09 %) received a perioperative blood transfusion. The need for blood transfusion according to route of hysterectomy was as follows: Total abdominal hysterectomy (TAH): 34/263 (12.92 %), Total laparoscopic hysterectomy (TLH): 5/119 (4.2 %), Laparoscopic assisted vaginal hysterectomy (LAVH): 3/35 (8.57 %), and Vaginal hysterectomy (VH): 5/100 (5.0 %) (Table 2). The mean estimated blood loss (EBL) in a total abdominal hysterectomy was 327.17 cc $\pm$ 306.30, which is 187.8 cc, 42 cc, and 128.8 cc greater than the mean EBL noted in TLH, LAVH, and VH, respectively. Hysterectomies performed with the

abdominal laparotomy route was a significant risk factor for perioperative blood transfusion ($p = 0.012$) (Table 2).

Table 1
Demographic characteristics

	TAH (n = 263)	TLH (n = 119)	LAVH (n = 35)	VH (n = 100)
Age $\pm$ SD	46.31 $\pm$ 9.40	46.58 $\pm$ 9.41	47.2 $\pm$ 9.46	58.19 $\pm$ 9.42
BMI in kg/m ² $\pm$ SD	30.9 $\pm$ 7.08	28.63 $\pm$ 7.13	31.44 $\pm$ 7.24	27.76 $\pm$ 7.11
Race n (%)				
Hispanic	135 (51.5%)	81 (68.0%)	20 (57.1%)	66 (66%)
African American	84 (31.8%)	25(21.0%)	7 (20%)	15 (15%)
Caucasian	44 (11.7%)	7 (5.8%)	7 (20%)	14 (14%)
Preop Hemoglobin (g/dl)	11.17 $\pm$ 1.89	11.66 $\pm$ 1.88	11.81 $\pm$ 1.90	12.29 $\pm$ 1.88
Preop Hematocrit (%)	35.72 $\pm$ 5.12	36.32 $\pm$ 5.10	36.98 $\pm$ 5.16	38.08 $\pm$ 5.10
Mean uterine weight (g)	578.70 $\pm$ 795.49	279.87 $\pm$ 800.85	182.26 $\pm$ 817.16	110.38 $\pm$ 797.35
Mean post op Hb (g/dl)	10.34 $\pm$ 1.65	10.53 $\pm$ 1.65	10.79 $\pm$ 1.67	11.03 $\pm$ 1.65
Mean post op Hct (%)	32.93 $\pm$ 4.48	32.86 $\pm$ 4.50	32.66 $\pm$ 4.54	34.07 $\pm$ 4.49
Mean EBL cc (SD)	327.17 $\pm$ 306.30	139.38 $\pm$ 307.55	285 $\pm$ 314.22	198.35 $\pm$ 307.284
Received transfusion n (%)	34 (12.9%)	5 (4.2%)	3 (8.5%)	5 (5%)
Converted to open n (%)	-	5 (4.2%)	3 (8.6%)	1 (1%)
Intra-op complications n(%)	5 (1.9%)	1 (0.84%)	0 (0%)	1 (1%)
TAH: Total abdominal hysterectomy, TLH: Total laparoscopic hysterectomy, LAVH: Laparoscopic assisted vaginal hysterectomy, VH: Vaginal hysterectomy. BMI: Body mass index Hb: Hemoglobin, Hct: Hematocrit, EBL: Estimated blood loss				

Table 2
Type of hysterectomy and the risk of receiving a perioperative blood transfusion.

Hysterectomy Type			
Abdominal Hysterectomy	34/263 (12.9%)	P = 0.012	
Laparoscopic Hysterectomy	5/119 (4.2%)		
Laparoscopic Assisted Vaginal Hysterectomy	3/35 (8.5%)		
Vaginal Hysterectomy	5/100 (5.0%)		
* Pearson Chi square			

The average uterine weight of those who did not receive a transfusion was 541.40 g $\pm$ 795.93 while the average uterine weight of those who required transfusion was 961.43 g $\pm$ 810.881. This difference was found to be statistically significant ($p = .001$) (Table 3). The mean BMI of patients requiring blood transfusion was 32.82 Kg/m² $\pm$ 7.20, while the BMI in the remainder of the cohort not receiving blood transfusion was 29.59 Kg/m² $\pm$ 7.09. This difference was also statistically ($p = 0.003$) (Table 3).

Table 3
Risk Factors for blood transfusion

	Transfusion	No Transfusion	
Uterine Weight (grams) $\pm$ SD	961.43 $\pm$ 810.881	541.40 $\pm$ 795.93	$p = 0.001$
Preoperative Hemoglobin (g/dL) $\pm$ SD	9.45 $\pm$ 1.92	11.76 $\pm$ 1.87	$p < 0.001$
BMI (kg/m ²) $\pm$ SD	32.82 $\pm$ 7.20	29.59 $\pm$ 7.09	$p = 0.003$
Presence of adhesions	24	70	$p = 0.026$
Personal history of c-section	13	127	$p = 0.123$
SD: Standard deviation			

Total abdominal hysterectomy, BMI and uterine size were all found to be statistically significant risk factors associated with need for perioperative blood transfusions during hysterectomy for benign disease.

The pre-operative mean hemoglobin in patients who did not receive a blood transfusion was 11.76 g/dl $\pm$ 1.87, compared to the mean hemoglobin in those who did receive a transfusion (9.43 g/dl $\pm$ 1.92), which was statistically significant ($p < 0.001$).

There was a statistically significant difference between the presence of adhesions ($p = 0.026$) and the need of blood transfusion. There was no association between a personal history of cesarean section ($p = 0.123$) and receiving a blood transfusion.

We explored the correlation between uterine size and risk of receiving a blood transfusion. In the total abdominal hysterectomy group, the average uterine weight in those who did receive a transfusion was 1,196.63 g, while the average weight in those who did not receive a transfusion was 896.33 g. This was not found to be a statistically significant difference ($P = .094$). When analyzing the patients who had a minimally invasive approach (TLH + LAVH + VH) the average uterine weight of those that received a blood transfusion compared to those who did not was similar ($p = 0.87$). Therefore, uterine weight was not identified as an independent risk factor for blood transfusion when controlling for route of hysterectomy.

We also looked at the risk of having a blood transfusion based on patient's race when controlling for type of hysterectomy. Hispanics patients were 1.21 more likely to receive a blood transfusion compared to Black women (OR 1.12), however the difference was not statistically significant ($p = 0.71$) (Table 4). When looking at risk of conversion to laparotomy of patients who had a laparoscopic approach (TLH + LAVH) based on race, it was noted that Hispanic women were 0.2 times more likely to undergo conversion to laparotomy, and this value was considered statistically significant ($p = 0.01$) (Table 5).

Table 4
Risk of blood transfusion based on patient's race

	Transfusion	No Transfusion	Odds Ratio	P value
White (as control)	5 (10.64%)	53 (12.07%)	0.14	0
Black	14 (29.79%)	114 (25.97%)	1.12	0.83
Hispanic	28 (59.57%)	114 (25.97%)	1.21	0.71
	P = 0.84			

Table 5
Risk of conversion to laparotomy based on patient's race

	Number Converted	Odds Ratio	P value
White (n/a no conversion)	0	—	—
Black (as control)		0.07	0
Hispanic		0.2	0.01

Discussion

In this cohort 9.09 % of all women received a perioperative blood transfusion. The greatest risk factor for receiving a blood transfusion was the open abdominal hysterectomy route compared to a minimally invasive procedure. It is well known that the open abdominal route involves a larger incision, more tissue manipulation and need for exposure and dissection. These factors put tissue integrity at risk and increases likelihood of blood loss and subsequent need of blood transfusion. However, a factor

frequently used by surgeon when choosing the route of hysterectomy is the preoperative estimation of the uterine size. This leads to another risk factor for perioperative blood transfusion: uterine weight. The average uterine weight in patients receiving a transfusion was 961.43g which was significantly higher than the average weight in those who did not receive a transfusion (541.40 g). Other studies have supported this finding by demonstrating that there is greater surgical blood loss in women who undergo hysterectomy with larger uterine size. Unger et al demonstrated that the risk of receiving blood transfusion was twice as much in women with uterine size greater than 1000 g compared to those less than 500 g [5]. Reasoning for greater blood loss and need for blood transfusion in those with larger uterine size largely involves the mechanics of surgical procedure. Larger uteri often have fibroids which can distort anatomy, making surgical exposure and ligation of vessels technically harder. Larger uteri are also more vascular, further increasing risk of blood loss. Our study did not show a significant difference in uterine weight with patient who received blood transfusions when controlling for type of procedure. This is likely multifactorial. There is not a large range in terms of uterine size amongst all minimally invasive surgeries so a significance between small differences in uterine weight wouldn't necessarily be expected. Additionally, as alluded to earlier, open abdominal surgical route is usually performed due to larger uterine size, thus, uterine weight and mode of procedure are confounding factors as size is a cause of decision for open procedure.

Interestingly, there was a higher risk of blood transfusion in patients with a higher BMI ($p = 0.003$). In patients who did not receive a blood transfusion, the mean BMI was 29.53 kg/m^2 , whereas the mean BMI of patients who received a transfusion was 33.01 kg/m^2 . This increased risk of transfusion in obese patients may be related to the increased complexity of performing surgery in obese patients or the increased amount of blood in adipose tissue dissected on entry into the peritoneum [7]. The larger surface area of subcutaneous fat exposed in obese patients may explain greater blood loss due to increased venous and arterial bleeding points, however this theory applies primarily to open procedures [7]. Another theory also explaining the higher risk of blood transfusion during hysterectomy of obese patients, has to do with altered cardiorespiratory physiology in obese patients which may account for greater blood loss and in turn, greater risk of requiring blood transfusion. Increased ventilation pressures required to overcome lower pulmonary compliance may result in higher venous pressures, therefore causing greater losses through venous oozing [7].

As expected, a lower pre-operative hemoglobin level was found to be a risk factor for perioperative blood transfusion with the mean hemoglobin of those getting a blood transfusion of 9.45 g/dl, as opposed to 11.76 g/dl in those who did not receive a transfusion ($p < .001$). This appears to be comparable to the pre-operative hemoglobin levels identified in other studies [1, 8]. Knowing the value of pre-operative hemoglobin that can decrease the risk of blood transfusion can assist with surgical planning and risk reduction from transfusion related reactions for patients. If possible, the surgeon should elect to medically optimize the patient before proceeding with the surgery.

We acknowledge several weaknesses of our study, including the retrospective nature and the biases that are naturally incurred when the data is collected retrospectively. Similarly, there is a selection bias when

comparing surgical approaches, as an open procedure may be selected if there is reason to believe that the uterus is too large for a minimally invasive approach. Another weakness encountered is the omission of robotic hysterectomies. Despite debates about increased cost of surgery and time, robotic surgical technology have gained popularity over the last decade due to believed better outcomes and decreased blood loss [9]. Additionally, surgeon skills and comfort level are different across the various modalities, and our study included multiple surgeons with different levels of expertise.

One of the strengths from this study is the sample size. While an even larger number of patients would give our study increased power, we believe that this number of patients was sufficient for the analysis of the variables that we analyzed. In addition, we attempted to control for several conditions that are considered risks factors of the need of perioperative blood transfusion.

Conclusion

Efforts to avoid the need for perioperative blood transfusion should always be considered when performing hysterectomy for benign disease. The open hysterectomy route, a large uterus, obesity, the presence of adhesions, and low preoperative hemoglobin are identified risk factors for perioperative blood transfusion. Women who are at greater risk of receiving perioperative blood transfusion based on the aforementioned factors should be counseled accordingly and adequately optimized for surgery to avoid unnecessary interventions at the time of surgery.

Declarations

Author contributions

M Saad-Naguib: project development, data analysis manuscript writing/editing

A Ulker: project development, data analysis, manuscript writing/editing

D Timmons: project development, data analysis

M Grady: Data collection, data analysis

M. Lederer: Data Analysis, data collection

J Carugno: project development, data analysis, manuscript writing/editing

Funding:

The authors received no funding for this manuscript and have no financial interest in it.

Conflicts of Interest:

The authors declare no conflict of interest regarding this manuscript.

Availability of data and material:

not applicable

Code availability:

not applicable

Ethics approval:

Institutional review board approval was determined not needed for this work. The patients signed informed consent allowing the de-identified publication of this manuscript.

Consent to participate:

not applicable

Consent for publication:

All authors consent to the publication of this manuscript. This work has not been presented or published previously in any format.

References

1. Risk Factors for Blood Transfusion in Women Undergoing Hysterectomy for Benign Disease. *Journal of Gynecologic Surgery*, 2012. 28(2): p. 108-112.
2. Wu, J.M., et al., Hysterectomy rates in the United States, 2003. *Obstet Gynecol*, 2007. 110(5): p. 1091-5.
3. Predictors of Transfusion Requirement Among Patients Who Undergo Hysterectomy for Benign Disease. *Journal of Gynecologic Surgery*, 2012. 28(2): p. 113-115.
4. Goodnough, L.T., Risks of blood transfusion. *Anesthesiol Clin North Am*, 2005. 23(2): p. 241-52, v.
5. Unger, J.B., R. Paul, and G. Caldito, Hysterectomy for the massive leiomyomatous uterus. *Obstet Gynecol*, 2002. 100(6): p. 1271-5.
6. Kanter, M.H., et al., Preoperative Autologous Blood Donations Before Elective Hysterectomy. *JAMA*, 1996. 276(10): p. 798-801.

7. Bowditch, M.G. and R.N. Villar, Do obese patients bleed more? A prospective study of blood loss at total hip replacement. *Ann R Coll Surg Engl*, 1999. 81(3): p. 198-200.
8. Gambone, J.C., R.C. Reiter, and J.B. Lench, Quality assurance indicators and short-term outcome of hysterectomy. *Obstet Gynecol*, 1990. 76(5 Pt 1): p. 841-5.
9. Rivas-Lopez, R. and F.A. Sandoval-Garcia-Travesi, Robotic surgery in gynecology: review of literature. *Cir Cir*, 2020. 88(1): p. 107-116.