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Rational blood transfusion in elective gynecologic surgeries in a tertiary hospital in the Philippines

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Abstract:

BACKGROUND: Blood transfusion plays a vital role in modern health care; however, local studies on the utilization of blood products intra-operatively, especially in elective gynecologic surgeries, are lacking.

OBJECTIVE: To determine the blood transfusion use during elective gynecologic surgical cases performed at a tertiary hospital in the Philippines. Methods: This retrospective descriptive study included data from patients admitted for elective gynecologic surgeries between January 2019 – December 2019. Pertinent data was gathered from the admission charts, preoperative laboratory results (hemoglobin levels, prothrombin time, partial thromboplastin time), blood bank records of deposited/donated blood and crossmatched units, anesthesia as well as intra-operative records, and medical charts. All abstracted variable were analyzed and transfusion indices were calculated.

RESULTS: Majority of the patients who underwent elective surgeries were from the general gynecologic service (60.4%), with abdominal hysterectomies comprising majority of the transfused patients. The calculated crossmatched-to-transfused ratio (C/T ratio) for pRBCs, FFPs, and PCs are 5.1, 7.6, and 19.7; the transfusion indices are 0.57, 0.44, and 0.17, while transfusion probabilities are 28.1%, 10.4%, and 4.2%, respectively. We found a significant association between transfusion status and primary service ($p = 0.01$), previous pregnancy ($p = 0.02$), preoperative hemoglobin count ($p < 0.01$), preoperative hematocrit ($p < 0.01$), postoperative hemoglobin count ($p < 0.01$), postoperative hematocrit ($p < 0.01$), and intra-operative blood loss ($p < 0.01$).

CONCLUSION: There is consistent over-ordering of blood products. Primary gynecologic service, previous pregnancy, preoperative hemoglobin and hematocrit, as well as introperative blood loss are factors associated with transfusion status.

Keywords:

Blood, blood transfusion, elective gynecologic surgeries

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Introduction

Blood transfusion plays a vital role in modern health care. If used appropriately, it may improve health and is a lifesaving method.[1] According to the World Health Organization, Clinical Blood use, blood transfusion practices are inconsistent and often show wide variations among procedures. Although there are procedures where significant blood loss is expected, most elective procedures do not result in sufficient blood loss.[2] Studies show gross over-ordering of blood for elective surgical procedures and often exceed both actual and anticipated needs. Over-ordering of blood products not only leads to substantial costs to the transfusion services but decreases the availability of cross-matched units while reserved for a specific patient.[3]

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Worldwide, the introduction of evidence-based transfusion guidelines and strategies for improved blood utilization has been shown to be safe and cost-effective.[3] Maximum Surgical Blood Order Schedule (MSBOS) was developed to anticipate normal blood usage for elective surgical procedures and to maximize usage of blood. It entails a list of the number of units of blood routinely requested and cross-matched for surgical procedures. This was based on a retrospective analysis of actual blood usage during different surgical procedures, and it aims to correlate the number of units cross-matched to the units transfused.[4] In a tertiary hospital in the Philippines, MSBOS is adopted and is published in the Blood Transfusion Medicine and the Blood Bank Manual.[5] It details 11 obstetric and gynecologic procedures and the suggested method to type and order, and the number of units [Table 1].

In the last year (2018), the Department of Obstetrics and Gynecology used a total of 5619 units, 4608 packed red cells, and 1485 of platelet and plasma product.[5] There is a >100% return rate as 6257 units were donated back for the department. This comprises 9% of the total blood use in the hospital. Despite the development of the MSBOS, there is a gradual increase in the ratio of cross-matched blood with the transfused blood from 1.7 in 2016, 1.6 in 2017 to 2.1 in 2018.[4] A closer look into the factors associated with blood transfusion and the rate of blood transfusion among different elective gynecologic procedures may decrease gross over-ordering of blood products.

Objectives

General objectives

This study aims to determine the blood transfusion use during elective gynecologic surgical cases performed at a tertiary hospital in the Philippines.

Specific objectives

- To determine the number of blood donated by patients who underwent elective gynecologic surgeries
- To identify significant factors that influenced the use of blood transfusion among elective gynecologic surgeries
- To investigate the rate of blood use according to the different procedures
    - Abdominal hysterectomy with or without adnexal surgery
    - Abdominal hysterectomy with tumor reductive surgery
    - Adnexal surgery (salpingectomy, salpingo-oophorectomy)
    - Myomectomy
    - Trachelectomy
    - Laparoscopic surgeries (diagnostic laparoscopy, laparoscopic adnexal surgeries, laparoscopic myomectomy, total laparoscopic hysterectomy)
    - Hysteroscopic surgeries (diagnostic hysteroscopy, hysteroscopic myomectomy, hysteroscopic polypectomy)
    - Vaginal hysterectomy
    - Vulvectomy
    - Vaginectomy.
- To calculate the different transfusion indices among elective gynecologic surgeries
- To determine the crossmatch to transfusion ratio among elective gynecologic surgeries.

Methodology

Study design

This is a retrospective descriptive study. The pertinent data were gathered from the admission chart, preoperative laboratory results (hemoglobin levels, prothrombin time, partial thromboplastin time), blood bank records of deposited/donated blood and crossmatched units, anesthesia as well as intraoperative record, and medical charts once protocol was approved by the Research Ethics Board.

Study setting

The study was done in the Department of Obstetrics and Gynecology of the tertiary hospital.

Table 1: Maximum surgical blood order schedule obstetrics and gynecology

Procedure	Preparatory test
Termination of pregnancy	Type and screen (T and S)
Normal delivery	Type and screen (T and S)
Cesarean section	Type and screen (T and S)
Dilatation and curettage	Type and screen (T and S)
Hysterectomy: Abdominal or vaginal (simple)	Type and screen (T and S)
Placenta previa/retained placenta	Cross-matching, 4 units (X - M 4)
Antepartum/postpartum hemorrhage	Cross-matching, 2 units (X - M 2)
Hysterectomy: Abdominal or vaginal (extended)	Cross-matching, 2 units (X - M 2)
Myomectomy	Cross-matching, 2 units (X - M 2)
Hydatidiform mole	Cross-matching, 2 units (X - M 2)
Oophorectomy (radical)	Cross-matching, 4 units (X - M 4)

Study population

All elective gynecologic surgery cases admitted in the past 12 months (January 2019–December 2019) were included.

Study duration

This study was conducted for 3 months from approval of the protocol by the Research Ethics Board.

Inclusion and exclusion Criteria

Inclusion criteria

All patients admitted under the service of Obstetrics and Gynecology who underwent elective gynecologic surgery were included in the study.

Exclusion criteria

Patient with histories of anticoagulant drug use, known coagulopathy, and hematologic conditions (e.g. Leukemia, anemia, hemophilia) were excluded from the study.

Sample size

Based on the medical records of the Department of Obstetrics and Gynecology, the number of patients that undergo elective gynecologic surgery per month is estimated to be $n = 150$. A review of charts in the last 12 months, from January 2019 to December 2019, a total of $n = 1800$ will be the total number of estimated patients who underwent elective gynecologic surgeries. On the other hand, the study of Boriboonhirunsarn in Thailand showed that the prevalence of blood transfusion in patients that underwent gynecologic surgery was 11.5%.[2] Using OpenEpi.com, the sample size for determining the prevalence of blood transfusion among patients undergoing gynecologic surgeries showed that given the prevalence in the study of Boriboonhirunsarn *et al.*, a level of significance a = 0.05 and 80% statistical power of test, the total number of size needed for the study will be $n = 134$ from the estimated population of $n = 900$. An additional 10% to the computed sample will be added to account for missing and miscoded data. Thus, the final sample size needed for the study will be $n = 148$. A random number generator, spanning from 1 to 1282, was used to select the cases.

Results

Overall, there was a total of 1282 elective gynecological cases performed for January 2019–December 2019; among these, 154 patient records (12.0%) were randomly selected and reviewed as per our sample size calculation. Majority of the patients who underwent elective surgeries were from the General Service (60.4%), followed by the reproductive endocrinology and infertility service (20.1%), gynecologic oncology (gyne-onco) service (14.9%), and the urogynecology and reconstructive pelvic surgery (uro-gyne) service (4.5%). The mean age of the patients was 47.69 ± 12.67 years, and the average body mass index (BMI) was 24.24 ± 4.04. Most of the patients already carried out pregnancies previously (77.9%), and only a few had previous abdominal surgeries done (9.1%).

Preoperatively, the major blood group type is O+ (50.0%), followed by B+ (23.4%), A+ (22.1%), and AB+ (4.5%). Among 134 patients whose preoperative blood parameters were recorded, the mean hemoglobin count was 123.95 ± 14.35, mean hematocrit was 0.38 ± 0.041, and mean platelet count was 328.82 ± 108.37. Total donated blood were 451 packed red blood cells (pRBCs), 211 fresh frozen plasmas (FFPs), and 211 platelet concentrates (PCs).

There were 16 types of surgeries performed for these patients; the predominant procedures done were abdominal hysterectomy with adnexal surgery (35.1%), followed by abdominal hysterectomy with tumor reductive surgery (25.3%), and vaginal hysterectomy (9.7%). Table 2 shows the total proportions of surgeries performed.

Transfusions were needed for 14.3% of these cases. Majority of the transfused patient underwent abdominal

Table 2: Number of surgeries per procedure performed

Type of elective gynecological surgery (percentage of total surgeries)	Specific gynecological surgery performed	Frequency (%)
Abdominal surgery (70.0%)	AHWAS	54 (35.1)
	AHWTRS	39 (25.3)
	ASO	2 (1.3)
	ASSO	5 (3.2)
	ELTB	1 (.6)
	MM	7 (4.5)
MIS (19.2%)	DHEC	3 (1.9)
	DL	1 (0.6)
	DLERH	1 (0.6)
	HM	1 (0.6)
	HP	6 (3.9)
	LAS	14 (9.1)
	LM	1 (0.6)
	TLH	3 (1.9)
Vaginal (10.8%)	VH	15 (9.7)
	VV	1 (0.6)
Total		154 (100)

AHWAS: Abdominal hysterectomy with adnexal surgery, AHWTRS: Abdominal hysterectomy with tumor reductive surgery, ASO: Adnexal surgery with oophorectomy, ASSO: Adnexal surgery with salphingo-oophorectomy, ELTB: Exploratory laparotomy with targeted biopsy, MM: Myomectomy, DHEC: Diagnostic hysteroscopy with endometrial curettage, DL: Diagnostic laparoscopy, DLERH: Diagnostic laparoscopy with excision of rudimentary horn, HM: Hysteroscopic myomectomy, HP: Hysteroscopic polypectomy, LAS: Laparoscopic adnexal surgery, TLH: Total laparoscopic hysterectomy, VH: Vaginal hysterectomy, VV: Vulvectomy, MIS: Minimally invasive surgery, LM: laparoscopic myomectomy hysterectomies (with adnexal surgery – 40.1%, with tumor reductive surgery – 40.1%). No trachelectomy nor vaginectomy were performed for the study period reviewed. Table 3 shows the total number of patients transfused per type of abdominal surgery.

The average operative blood loss was tagged at 452.01 ± 399.21 mL. The total number of crossmatched blood was 454 units of pRBCs (100%), 160 units of FFPs (75.83%), and 158 units of PCs (74.88%). The total number of released blood was 90 units of pRBCs (19.8%), 21 units of FFPs (13.1%), and 8 units of PCs (5.1%). The calculated crossmatched-to-transfused ratio (C/T ratio) for pRBCs, FFPs, and PCs were 5.1, 7.6, and 19.7; the transfusion indices were 0.57, 0.44 and 0.17, while transfusion probabilities were 28.1%, 10.4%, and 4.2%, respectively. Table 4 shows the calculated transfusion indices for pBRC, fresh frozen plasma, and platelet concentrate.

One-way analysis of variance was done to determine any difference between transfused and nontransfused groups in terms of our continuous independent variables. We found a significant difference with preoperative hemoglobin count (transfused vs. nontransfused) (mean = 117.8 ± 17.6 vs. 126.9 ± 12.2, $P < 0.01$), postoperative hemoglobin count (mean = 110.5 ± 19.0 vs. 118.8 ± 12.5, $P < 0.01$), preoperative hematocrit (mean = 0.36 ± 0.05 vs. 0.39 ± 0.04, $P < 0.01$), postoperative hematocrit (mean = 0.35 ± 0.06 vs. 0.37 ± 0.04, $P = 0.01$), and intraoperative blood loss (mean ==842.9 ± 483.6 vs. 343.0 ± 236.1, $P < 0.01$).

No significant difference was found with age ($P = 0.39$), BMI ($P = 0.43$), preoperative platelet counts ($P = 0.25$), postoperative platelet counts ($P = 0.19$), preoperative elevation in prothrombin time ($P = 0.36$), and preoperative elevation in partial thromboplastin time ($P = 0.37$).

Chi-square was done to determine any difference between transfused and nontransfused groups in terms of our categorical variables. We found a significant association between transfusion status and primary service ($P = 0.01$), as well as previous pregnancy ($P = 0.02$). However, we did not find any significant association with type of abdominal surgery ($P = 0.07$) neither with blood type ($P = 0.64$).

Discussion

The World Health Organization defines the appropriate use of blood and blood products as an intervention only necessary "to treat a condition leading to significant morbidity or mortality that cannot be prevented or managed effectively by other means."[6] In the local setting, for patients being scheduled for elective surgeries, it is a common practice to advise the patients to preemptively donate blood products from their relatives

Table 3: Number of patients transfused per type of surgery

Type of elective gynecological surgery (percentage of total transfused)	Transfused		Percentage transfused per specific surgery
	N	Y	
Abdominal (95.3%) surgeries			
AHWAS	37	17	31.5
AHWTRS	20	19	48.7
ASO	1	1	50.0
ASSO	4	1	20.0
ELTB	1	0	
MM	4	3	42.9
MIS (4.7%)			
DHEC	3	0	
DL	1	0	
DLERH	1	0	
HM	1	0	
HP	5	1	16.7
LAS	13	1	7.1
LM	1	0	
TLH	3	0	
Vaginal surgeries (--)			
VH	15	0	
VV	1	0	
Total	132	43	

MIS: Minimally invasive surgery, AHWAS: Abdominal hysterectomy with adnexal surgery, AHWTRS: Abdominal hysterectomy with tumor reductive surgery, ASO: Adnexal surgery with oophorectomy, ASSO: Adnexal surgery with salphingo-oophorectomy, ELTB: Exploratory laparotomy with targeted biopsy, MM: Myomectomy, DHEC: Diagnostic hysteroscopy with endometrial curettage, DL: Diagnostic laparoscopy, DLERH: Diagnostic laparoscopy with excision of rudimentary horn, HM: Hysteroscopic myomectomy, HP: Hysteroscopic polypectomy, LAS: Laparoscopic adnexal surgery, TLH: Total laparoscopic hysterectomy, VH: Vaginal hysterectomy, VV: Vulvectomy, LM: laparoscopic myomectomy

Table 4: Transfusion indices for packed red blood cells, fresh frozen plasma, and platelet concentrate per type of surgery

Transfusion indices for pRBC	Number of patients transfused	Units crossmatched	Units transfused	C/T	TI	TP (%)
Abdominal surgeries						
AHWAS	15	174	43	5.1	2	31.5
AHWTRS	20	148	41	3.6	2.1	48.7
ASO	1	6	1	6	1	50.0
ASSO	1	13	1	13	1	20.0
ELTB	0	4	0	-	-	-
MM	3	22	7	3.1	2.3	42.9
Minimally Invasive Surgeries						
DHEC	0	3	0	-	-	-
DL	0	2	0	-	-	-
DLERH	0	2	0	-	-	-
HM	0	3	0	-	-	-
HP	2	8	2	4	2	16.7
LAS	1	26	4	6.5	4	7.1
LM	0	4	0	-	-	-
TLH	0	6	0	-	-	-
Vaginal surgeries				-	-	-
VH	0	31	0	-	-	-
VV	0	2	0	-	-	-
Total	43	454	90	5.1	0.57	28.1
Transfusion indices for fresh frozen plasma	**Number of patients transfused**	**Units crossmatched**	**Units transfused**	**C/T**	**TI**	**TP (%)**
Abdominal surgeries						
AHWAS	3	67	8	8.4		14.3
AHWTRS	4	68	13	5.2	0.4	22.2
ASO	0	0	0	-	0	-
ASSO	0	0	0	-	0.70	-
ELTB	0	4	0	-	-	-
MM	0	14	0	-	-	-
Minimally Invasive Surgeries						
DHEC	0	0	0	-	-	-
DL	0	0	0	-	-	-
DLERH	0	0	0	-	-	-
HM	0	0	0	-	-	-
HP	0	0	0	-	-	-
LAS	0	0	0	-	-	-
LM	0	0	0	-	-	-
TLH	0	0	0	-	-	-
Vaginal surgeries						
VH	0	0	0	-	-	-
VV	0	0	0	-	-	-
Total	7	160	21	7.6	0.44	10.4
Transfusion indices for platelet concentrate	**Number of patients transfused**	**Units crossmatched**	**Units transfused**	**C/T**	**TI**	**TP (%)**
Abdominal surgeries						
AHWAS	2	28	6	3.3	0.3	10
AHWTRS	1	12	2	9	0.1	5.5
ASO	0	0	0	-	-	-
ASSO	0	0	0	-	-	-
ELTB	0	1	0	-	-	-
MM	0	5	0	-	-	-
Minimally Invasive Surgeries						
DHEC	0	0	0	-	-	-
DL	0	0	0	-	-	-

Contd...

Table 4: Contd...

Transfusion indices for pRBC	Number of patients transfused	Units crossmatched	Units transfused	C/T	TI	TP (%)
DLERH	0	0	0	-	-	-
HM	0	0	0	-	-	-
HP	0	0	0	-	-	-
LAS	0	0	0	-	-	-
LM	0	0	0	-	-	-
TLH	0	0	0	-	-	-
Vaginal surgeries						
VH	0	2	0	-	-	-
VV	0	1	0	-	-	-
Total	3	47	8	19.7	0.17	4.2

AHWAS: Abdominal hysterectomy with adnexal surgery, AHWTRS: Abdominal hysterectomy with tumor reductive surgery, ASO: Adnexal surgery with oophorectomy, ASSO: Adnexal surgery with salphingo-oophorectomy, ELTB: Exploratory laparotomy with targeted biopsy, MM: Myomectomy, DHEC: Diagnostic hysteroscopy with endometrial curettage, DL: Diagnostic laparoscopy, DLERH: Diagnostic laparoscopy with excision of rudimentary horn, HM: Hysteroscopic myomectomy, HP: Hysteroscopic polypectomy, LAS: Laparoscopic adnexal surgery, TLH: Total laparoscopic hysterectomy, VH: Vaginal hysterectomy, VV: Vulvectomy, MIS: Minimally invasive surgery, C/T: Crossmatched-to-transfused, LM: laparoscopic myomectomy, TP: transfusion probability, TI: transfusion indices

for the patients' use. If schedules are further pushed to a minimum of 3 months ahead, iron supplementation can be and is usually advised to raise hemoglobin counts; however, the perioperative period itself raises the risk of eventual anemia due to the blood losses concurred through surgery.[7] Therefore, supplementation alone will be limited, and transfusions maybe necessary.

In our institution, there exist no guidelines in requesting preoperatively for blood products in elective gynecological surgeries; the discretion lies in the attending surgeon based on preoperative blood parameters and anticipated blood loss depending on the complexity of the surgery. Anecdotal evidence points toward a habit of ordering at least two units of packed RBC for cases deemed benign and at least four units for cases deemed complex. In this study, all donated pRBCs are preemptively crossmatched for surgical use (100% of donated units), while a significant number of other donated blood products are also crossmatched (FFPs: 75.83% of donated units; PCs: 74.88% of donated units). However, less than a third of these cases actually required transfusions. Abdominal hysterectomies comprise the majority of these cases; however, some cases were associated with higher frequencies of transfusions. Almost half of the patients who underwent myomectomy needed eventual transfusions (2/5, 40.0%). A third of patients who were subjected to cytoreductive surgery required transfusions (9/30, 30.0%), while a quarter of patients who underwent adnexal surgery with salphingo-oophorectomy needed blood products (1/4, 25.0%).

A recent multicenter study involving women undergoing myomectomy (n = 3407) found that the risk for transfusion during or within 72 h of operation is about 10%, with hysteroscopic myomectomies comprising 6.7% of these transfusions.[8] The authors hypothesized that improved hysteroscopic techniques that deal with enhanced optical instruments and morcellation devices that permit removal of larger submucosal fibroids, increasing the propensity for operative bleeding and transfusion. In this study, we have recorded a total of 7 myomectomy procedures; 5 abdominal myomectomies, 1 laparoscopic myomectomy, and 1 hysteroscopic myomectomy. Two cases of abdominal myomectomies required transfusions; however, the limited number preclude us from correlating the size, number, and location of the myomas with transfusion status.

Anemia is prevalent in oncologic cases, primarily due to dysfunction in marrow production (from metastases or chemoradiation therapy), decrease in renal function (from chemotherapy), and direct blood loss (from tumor bleed or surgical bleed).[9] Reported risk factors for transfusion in gynecologic cancer patients include BMI and larger uterine size;[10] in this study, BMI was not associated with transfusion status.

Overall, laparoscopic surgeries are associated with decreased transfusion since smaller instruments allow for permissive yet sufficient cuts along the organs that result to less hemoglobin drops and blood loss.[3,11,12] In this study, there was a total of 18 laparoscopic procedures performed; one case of laparoscopic adnexal surgery required transfusion (5.5%). However, a larger sample size and a separate study must be done to provide significant evidence for this finding.

Baseline characteristics were not significantly different between transfused and non-transfused groups; however, we found that hematocrit and hemoglobin counts are significantly lower in the transfused group. This is in agreement with a previous report that patients who received transfusion had lower preoperative hematocrit levels as well as increased intraoperative blood loss.[13] Preoperative anemia was also higher in gynecological surgery patients who underwent transfusion.[14] In addition, no significant association was established with type of abdominal surgery and transfusion status.

Intraoperative blood loss was also significantly higher in the transfused group. Some literature have reported estimated blood loss can be used to direct transfusion decisions. In a large retrospective study among surgery patients, there was an association between intraoperative blood transfusion and 30-day postoperative mortality, especially in patients with Hct of 30% or greater in which there was significant operative blood loss (500–999 mL) (odds ratio [OR] 0.35, 95% confidence interval [CI] = 0.22–0.56).[15] Several other guidelines on gynecological surgeries call for transfusions when certain thresholds for intraoperative blood loss are reached, depending on the preoperative status of the patient.[10,16,17]

It is also important to note that transfusions were only done intraoperatively (44.2%) or postoperatively (55.8%), and no transfusions were needed prior to surgery. As mentioned earlier, despite a significant difference between the transfused and nontransfused groups in terms of preoperative hemoglobin count, the mean counts are still above transfusion threshold levels.

This is the first study to determine an association between previous pregnancy and transfusion status. This is a significant finding, as most of our patients for elective surgeries have already had previous pregnancies (77.9%).

Our frequencies for transfusions significantly vary from those in the literature (0.3–11%, 4%, 8.6%, and 28% for hysterectomies; 7%, 21% for myomectomy; 78% for cytoreductive surgery), as expected to be reflected by multiple factors, such as overall hospital health care status, preoperative health conditions of patients, and inherent surgeon competence.[2,6,18,19] The association between primary service and transfusion status may be explained by the type of surgeries performed per service; abdominal hysterectomies were primarily performed by the General Service. It was previously reported that abdominal hysterectomy itself was a significant risk factor for the need to receive blood transfusion;[20] however, we observe a disjunct since there was no significant association found between transfusion status and type of abdominal surgery. It can be therefore surmised that other factors may affect transfusion status, such as surgeon skill, intraoperative patient parameters (e.g., anesthesia, vital signs during the intraoperative course), and the degree of complexity of the operation. Subjective calls of the surgeon and the anesthesiologist may also play roles in intraoperative transfusion judgments. A prospective study regarding intraoperative transfusion practices concluded that "physiologic trigger irrespective of hemoglobin" is the most common indication for transfusion of blood products.[21] This study did not cover such decision calls from the primary surgeon versus the anesthesiologist; this factor remains to be confirmed in a separate study.

Overall, this study provides definitive evidence that there is consistent over-ordering of blood products for these kinds of surgeries. The calculated C/T ratios (pRBCs 5.1, FFPs 7.6, and PCs 19.7) are way beyond our ideal targets of <2.5. The C/T ratio states the tendency to over-order blood products; evidently, the number of cross-matched units was sufficiently larger compared to the transfused units.[22] The high C/T ratios observed for gynecologic surgeries in this study agree well with multiple other studies from the literature, suggesting that gynecologic surgeries belong to one of the most frequently excessive surgeries in terms of blood product acquisition.[23-26] However, the C/T ratio does not determine the likelihood of transfusion for a particular procedure and does not measure the appropriateness of the number of units ordered for a particular procedure.

Thus, better measures were subsequently introduced. The transfusion probability is the number of patients transfused/number of patients cross-matched ×100. Procedures with <30% of transfusion probabilities have a reduced transfusion risk and as such would be recommended for typing and screening of subsequent units.[27] Another measure is the transfusion index, defined as the average number of units used per patient cross-matched.[28] For this study, the calculated transfusion probabilities (pRBCs 28.1%, FFPs 10.4%, and PCs 4.2%) and transfusion indices (FFPs 0.44, and PCs 0.017) met our targets of <30% and <0.50, respectively. The packed RBC transfusion index was minimally higher at 0.57. Comparing to the literature, we find similar results with other gynecological units from other institutions in other developing worlds.[12-15] Table 5 shows the C/T ratios, transfusion probabilities, and transfusion indices from the literature.

The transfusion indices can then be multiplied by 1.5 to determine the MSBOS, which is a set of elective procedures with corresponding number of blood units routinely crossmatched preoperatively [Table 6].[17] Therefore, for elective gynecological procedures, schedules for the individual blood products are 0.85 units for pRBCs, 0.66 units for FFPs, and 0.025 units for PCs. The small values may then prove an argument that surgeons must have a better and prudent insight of the patients' conditions prior to the operation to reduce the routine ordering of blood products for these surgeries.

Recently, a mathematical model predicting the risk for transfusion was developed through a large cohort of women undergoing various gynecologic surgeries. Low preoperative hemoglobin, history of co-morbids (hypertension, ovarian cancer), laparotomy, myomectomy, and a procedure for malignancy increased the likelihood of eventual transfusions.[9] A similar study that could determine which patients would eventually need blood products may be helpful, especially in a setting of limited resource.

In addition, over transfusion has been associated with increased risk for mortality. A study reported higher composite morbidity (OR = 1.85, 95% CI 1.5–2.24), surgical site infections (OR 1.80, 95% CI 1.39–2.35), mortality (OR 3.38, 95% CI 1.80–6.36) and length of hospital stay (3.02 days v. 7.17 days, $P < 0.001$) with perioperative transfusions.[5] In addition, overall survival and disease-free survival 3 years' postsurgery were significantly decreased in patients who received packed red blood cell transfusions versus those who did not (58.9% vs. 74.5%, 39.6% vs. 52.3%).[29] Thus, tighter blood transfusion protocols may be of significant benefit to our patients.

Overall, we see a dramatic over-ordering of blood products for the majority of our surgeries. Usually, the attending surgeon requests units of blood greater than the patient has acquired or expected to received to increase the safety net in cases of unforeseen intraoperative bleeding. However, as common practices are endorsed among colleague physicians, preoperative requests of blood become a habitual practice.[30] Crossmatched blood that is pulled out from the blood bank is typically reserved as standby units for either the surgeon or anesthesiologist; this increases the likelihood of a more rapid expiry leading to disposal and unuse.[31] Allowing it to be exposed to nonoptimal storage conditions (e.g., back-and-forth transfer between the operating room and the blood bank, standby in non-optimized areas) may decrease shelf life of packed RBCs and may affect its therapeutic value. A stricter guideline, priming of proper MSBOS and type-and-screen practices among surgical specialties, and local auditing of blood usage practices through a multi-disciplinary hospital transfusion committee may allow for more efficient blood usage as well as net savings for the department.[19,32,33]

For consistency in future gynecologic procedures, surgeons in this institution may opt to follow computed MSBOS; this may guide them in the management of anticipated intraoperative or postoperative blood losses, as well as provide blood donors with more judicious expectations for blood product donations for their recipient patients. If done so, a follow-up study would provide a good understanding on whether this tighter control of blood product use would lead to better surgical outcomes, more efficient utilization of hospital resources, and overall better satisfaction for the patients and the involved donors. Subjective discretion, however, would still be warranted for these cases as expected for the eventual surgeon, and blood products may still be ordered if deemed necessary. Overall, a combination of previously reported literature factors, such as preoperative hemoglobin and hematocrit, intraoperative blood loss, type of intervention (laparotomy, myomectomy, and hysterectomy), and our newly identified factors, such as the primary service performing the surgery as well as previous pregnancy, may provide direction as to intraoperative transfusion decisions.

Our study reached our computed sample size; however, a longer duration of the study period as well as a larger sample size may provide a more robust association or nonassociation between transfusion status and the variables of interest. For succeeding researches, sample size calculations may also take into consideration the different types of surgeries, to obtain an appropriate number for each specific procedure that would provide sufficient power for analysis. Other factors, such as intraoperative events and surgeon competence may also be included in future analysis. Additionally, the decisions, protocols, and prevailing practices for ordering

Table 5: Crossmatched-to-transfused ratios, transfusion probabilities, and transfusion indices across various studies published for gynecologic surgeries

Authors	Year	Country	C/T ratio	Transfusion probability	Transfusion index
Gamo *et al.**	2020	Philippines	5.1	28.1	0.57
Zewdie *et al.*	2019	Ethiopia	7.69	16.33	0.27
Yazdi *et al.*	2016	Iran	18.6	3.37	0.06
Aryal *et al.*	2016	Nepal	4.44	9.83	0.27
Belayneh *et al.*	2013	Ethiopia	2.9	48	0.49

*Current study, **Ideal C/T ratio <2.5, ideal transfusion probability <30%, ideal transfusion index <0.5. C/T: Crossmatched-to-transfused

Table 6: Blood transfusion parameters calculated for the study

	Donated	Cross-matched	Released	Cross-matched-to-ransfusion ratio	Transfusion indices	Transfusion probability	Max surgical blood order
pRBC	451	454	4	5.1	0.57	28.1	0.85
FFP	211	160	8	7.6	0.44	10.4	0.66
Platelet	211	158	2	19.7	0.017	4.2	0.025
				<2.5	<0.5	<30%	

pRBC: Packed red blood cells, FFP: Fresh frozen plasmas of blood products and their eventual transfusions may be different across institutions.

Nonetheless, the inclusion of other major hospitals in the locality may decrease referral biases that may occur if this study was done as a single-center study only and may provide a relatively wider insight to the situation of the use of blood products.

Conclusion

To the best of our knowledge, this is the first local study to explore the transfusion practice in gynecologic surgeries in the country. Our study found that there is consistent over-ordering of blood products. Primary gynecologic service, previous pregnancy, preoperative and postoperative hemoglobin, and hematocrit values, as well as intraoperative blood loss are factors associated with transfusion status. It is suggested that for elective gynecologic surgeries, attending surgeons must base their blood schedules on the values computed in this study to minimize excessive use, rationalize proper blood use, and optimize erythropoiesis for admitted patients.

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Conflicts of interest
There are no conflicts of interest.

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