Canadian Oncology Nursing Journal

Revue canadienne de soins infirmiers en oncologie

Volume 32, Issue 1 • Winter 2022
eISSN: 2368-8076

CANO
ACIO

Canadian Association of Nurses in Oncology
Association canadienne des infirmières en oncologie

The incidence of perioperative anemia and iron deficiency in patients undergoing gynecology surgery

by Saudia Jadunandan, Ruby Tano, Danielle Vicus, Jeannie Callum, Yulia Lin

ABSTRACT

Preoperative anemia is progressively being recognized as a risk factor for poor perioperative outcomes including increased length of hospital stay and increased blood transfusions. The growth in prevalence of preoperative anemia in patients undergoing gynecological oncology procedures warrants greater attention to early identification for optimal surgical outcomes. This was a quantitative retrospective observational study consisting of 284 patients undergoing gynecological oncology procedures. The study sought to determine the frequency of anemia, iron deficiency and the effect of anemia on the number of blood transfusions from January 1 to December 31, 2014. Patients with anemia had significantly higher transfusion rates (44% versus 11%, $p < 0.0001$), considerably higher number of units transfused per patient (mean 1.19 units versus 0.28 units, $p < 0.0001$) and longer length of stays post-operatively (mean 5.9 days versus 4.6 days, $p=0.0008$). It was concluded that early identification and treatment of anemia is a key opportunity to optimized surgical outcomes.

Keywords: anemia, iron studies, gynecological oncology procedures

AUTHOR NOTES

Saudia Jadunandan, Department of OR and Related Services, Sunnybrook Health Sciences and Ontario Transfusion Coordinators Network, University of Toronto, Ontario, Canada

Ruby Tano, Department of OR and Related Services, Sunnybrook Health Sciences and Ontario Transfusion Coordinators Network, University of Toronto, Ontario, Canada

Danielle Vicus, Division of Gynecology, Sunnybrook Health Sciences Centre and Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Jeannie Callum, Department of Laboratory Medicine and Molecular Diagnostics, Sunnybrook Health Sciences Centre; Department of Laboratory Medicine and Pathobiology, University of Toronto; and University of Toronto Quality in Utilization, Education and Safety in Transfusion (QUEST) Research Program, Toronto, Ontario, Canada

Yulia Lin, Department of Laboratory Medicine and Molecular Diagnostics, Sunnybrook Health Sciences Centre; Department of Laboratory Medicine and Pathobiology, University of Toronto; and University of Toronto Quality in Utilization, Education and Safety in Transfusion (QUEST) Research Program, Toronto, Ontario, Canada

INTRODUCTION

Preoperative anemia is increasingly recognized as an associated risk factor for poor perioperative outcomes (Fowler et al., 2015; Mueller et al., 2019; Musallam et al., 2011; Njolstad et al., 2013). Clevenger et al. (2015) suggest that anemia diminishes a patient's appropriateness for surgery and increases the risk of harmful outcomes. The prevalence of preoperative anemia is common in patients undergoing gynecological oncology procedures (Nelson et al., 2019). After adjusting for confounding factors and using multivariate logistic regression, preoperative anemia is an independent risk factor for postoperative morbidity and mortality, blood transfusion, and longer length of stay in hospital (Munoz, Acheson, et al., 2017).

Anemia is also recognized as a significant predisposing factor for the patient to require a perioperative blood transfusion (Fowler et al., 2015; Freedman, 2014; Klein et al., 2016). This treatment is independently associated with increased complications, such as transfusion-related injuries and other adverse outcomes (Delaney et al., 2016). For these reasons, finding opportunities for patient blood management for gynecologic oncology surgical patients is warranted.

The British Committee for Standards in Hematology and Enhanced Recovery After Surgery (ERAS) Society guidelines recommend that anemia screening should occur when the referral for surgery is first made, allowing time for proper investigation and correction (Kotze et al., 2015; Nelson et al., 2019). The main treatable causes of anemia in the gynecologic oncology surgical population include iron deficiency, vitamin B12 deficiency and ongoing blood loss (Okocha et al., 2020). Examining institutional practices and identification of preoperative anemia guidelines for gynecologic cancers is a first step that could result in improved patient blood management, utilization of blood bank resources, and clinical outcomes (Njolstad et al., 2013).

The primary research question of this study was to identify the frequency of anemia and iron deficiency in preoperative gynecologic patients and the effect of anemia on the number of blood transfusions during or following surgery in comparison with patients without preoperative anemia.

METHODS

This retrospective, observational study of consecutive gynecologic oncology patients undergoing surgery was conducted between January 1 and December 31, 2014. Institutional research ethics board approval was obtained. Inclusion criteria were consecutive patients who had an open gynecology oncology surgery of the uterus and ovary between January 1

DOI: 10.5737/236880763217580

and December 31, 2014, at our institution. Laparoscopic procedures were excluded. If a patient received more than one elective open approach surgery in 2014, only the first surgery was included.

Data from the electronic medical chart were collected including dates of the first surgeon visit, preoperative assessment visit, and surgery. The date of the first surgeon visit was defined as the first time the patient saw the surgeon. Occasionally, this was several months or years before the surgery, and a decision for surgery had not yet been made. If the visit was more than six months prior to surgery, the first surgeon visit was defined as the date when the decision to proceed with surgery was made.

Data were also collected regarding laboratory tests results, including hemoglobin (g/L), mean cell volume (MCV) (fL), ferritin (mcg/L), transferrin saturation (%), and were assigned to the dates described above. Labs assigned to the first surgeon visit were within the range of 30 days prior and seven days after the first surgeon visit. The Anesthesiology Preassessment visit was defined as the preoperative appointment with the patient and the anesthesiologist to identify comorbidities that might lead to patient complications during the anesthetic, surgical, or postoperative period. Patient comorbidities were not collected in this study. However, comorbidities are assessed at the preoperative appointment. Preoperative hemoglobin was defined as the hemoglobin within seven days prior and closest to the surgery date. Postoperative hemoglobin was defined as the first hemoglobin value after the surgical end time. The nadir hemoglobin was defined as the lowest hemoglobin during admission. Discharge hemoglobin was defined as the last hemoglobin before the patient was discharged from the hospital after surgery. The blood bank lab information system (HCLL, Medware, Kansas City) was used to determine if red blood cells were transfused and the total number of units transfused during the hospital admission of the index surgery. Multiple transfusions over the duration of the hospital admission and multiple units of red blood cells that were given at one time were reflected in the total number of transfusions.

The primary outcomes were the frequencies of anemia and iron deficiency in the preoperative phase at each time point: first surgeon visit, preassessment visit, and day of procedure (using the preoperative hemoglobin value). Anemia was defined according to the World Health Organization (WHO) (2011) definition for women as hemoglobin less than 120 g/L. Each patient was categorized as having anemia, no anemia or insufficient data at each time point. Iron deficiency was defined as a serum ferritin <30 µg/L; or ferritin <100 µg/L and TSAT <20% (Kotze et al., 2015) and each patient was coded as having iron deficiency, adequate iron or insufficient data.

Secondary outcomes included:

1. The mean time (in days) available for treatment of preoperative anemia: time from the first surgeon's visit to the pre-assessment appointment and to the date of surgery
2. Association of preoperative anemia with red blood cell transfusion during or following the gynecology oncology patient's surgery compared with those without anemia.

Statistical Analysis

The sample size was one of convenience, as all patients meeting the inclusion criteria were included. At an estimated transfusion rate of 32%, a sample of 300 charts would provide a two-sided 95% confidence interval ranging from 26.8% to 37.6% around this estimate.

Descriptive statistics were reported as means with standard deviations (SD), or as medians with interquartile ranges (IQR) if data were skewed. Categorical variables were reported as a percentage of the total study population or applicable subpopulations. An unpaired t-test was used to calculate differences between the group with anemia and the group without anemia. Natural log-transformation was applied for some continuous variables to normalize distributions as appropriate. All *p* values less than 0.05 were considered statistically significant. Calculations were performed using spreadsheet software (Excel 2016; Microsoft Corporation) and GraphPad Prism (Version 6.04 for Windows, GraphPad Software, La Jolla California USA, www.graphpad.com). The primary outcome measures, frequencies of anemia and iron deficiency anemia, were summarized with proportions and 95% confidence intervals (CI). The secondary analysis was performed using a Chi-square test (or Fisher's exact test as appropriate) comparing the proportion of transfusions among those with and without anemia.

RESULTS

During the study period, there were 297 consecutive patients who underwent gynecology oncology surgery with a laparotomy. Thirteen cases were excluded as some patients had undergone a repeat surgery in the same year (12 patients) or access to the medical record was not available (one patient). Thus, 284 patients undergoing their first procedure were included in the study. The mean age of participants was 60.1 years. In the cohort, 48% of patients had less than 28 days between the initial surgical consultation and their surgery and no dates were recorded in the patient chart for 2% of the sample.

Forty-three percent (95% CI: 37.6-49.1%) of the patients were identified as having preoperative anemia anytime before surgery (Table 1). Only 11% had preoperative iron studies, and none were identified as having iron deficiency. The median ferritin was 156 (IQR 81-318) and TSAT was 0.20 (IQR 0.11-0.26) (Figure 1). At the initial surgical visit or surgery decision date, 42% of patients had a hemoglobin test completed and 10% had both hemoglobin and iron studies.

In terms of opportunity to correct anemia preoperatively, 50% of patients had more than 28 days between their initial surgeon visit and the surgery date. Forty-one percent of patients had their first hemoglobin test at the initial visit, while 55% did not have their first hemoglobin recorded until the preassessment date, which was a median of eight days prior to surgery (Table 1).

Patients with anemia had significantly higher transfusion rates (44% versus 11%, *p* < 0.0001) and a significantly higher number of units transfused per patient (mean 1.19 units vs. 0.28 units, *p* < 0.0001; Figure 2). This study did not differentiate

Table 1

Preoperative Anemia Prevalence and Testing prior to Gynecologic Oncology Surgery (Uterine surgery- Open Myomectomy or Hysterectomy in Oncology Patients)

Age (mean $\pm$ SD)	60.1 $\pm$ 13.7
No. of Patients Included	276
Patients with Hg at Initial Surgeon Visit, N (%)	148 (52)
Patients with Preoperative Iron Studies at Initial Surgeon Visit, N (%)	31 (11)
Patients with both Hg and Iron Studies at Initial Surgeon Visit, N (%)	29 (10)
Patients with Preoperative Anemia per 276 tested patients, N (%) any time Before Surgery	102 (37)
Patients with Pre-Operative Iron Deficiency, N (%)	0 (0)
Time from initial surgeon visit or decision date to surgery N (%)	
14 days or less to surgery date	52 (18)
Between 14 and 28 days to surgery date	84 (30)
Over 28 days to surgery date	141 (50)
Unknown	7 (2)
Earliest Hg Recorded N (%)	
Initial Visit or Surgery Decision Visit	116 (41)
Pre-Assessment Date	156 (55)
Within 7 days prior to Surgery (Preoperative)	12 (4)
No Hg recorded	0 (0)
Time to Manage Anemia (Median [IQR])	
Days From First Visit Date/Decision Date To Surgery	29 [16–47]
Days From First Visit Date/Decision Date To Pre-assessment	15 [9–31]
Days From Pre-assessment To Surgery	8 [5–17]

whether transfusion rates were measured on one transfusion or multiple. The group of patients with anemia had longer length of stays post-operatively (mean 5.9 days versus 4.6 days, $p=0.0008$) (Table 2).

DISCUSSION

The nature of the sample was reflective of patients typical of the gynecologic oncology population. The main findings revealed more than one-third of the preoperative patients

Figure 1

Preoperative hemoglobin, ferritin and transferrin saturation (TSAT). The boxplots show hemoglobin pre-op ($n = 276$), Ferritin pre-op ($n = 31$), and TSAT pre-op ($n = 15$). The box represents the interquartile range (IQR) between the 25th and 75th percentile (IQR) and the horizontal line in the middle of the box represents the median. The upper whisker represents the 75th percentile + 1.5 IQR and the lower whisker represents the 25th percentile – 1.5 IQR.

Figure 2

Proportion of patients transfused by preoperative hemoglobin (g/L) (N=276)

undergoing a gynecology oncology procedure were identified as having anemia. Anemia was identified in most patients one week before the procedure, and anemic patients were more likely to get transfused. If they were transfused, they received more units and their length of stay in hospital was prolonged by one day. In relation to time prior to surgery, 50% of patients had more than 28 days between their initial surgeon visit and their surgery date. However, greater than half of those patients (55%) did not have their first hemoglobin recorded until the

Table 2*Comparison of Outcomes for Patients with regards to Preoperative Anemia (N=276)*

	Anemia	No Anemia	p
No. of Patients N (%)	102 (37)	174 (63)	
Patient Age (mean $\pm$ SD)	59.1 $\pm$ 14.4	61.1 $\pm$ 13.3	0.25
RBC transfusion post-operatively N (%)	45 (44)	19 (11)	<0.0001
No. of RBC Units	121	49	
No. of RBC Units/Patient transfused (mean $\pm$ SD) *	1.19 $\pm$ 2.2	0.28 $\pm$ 1.1	<0.0001
Days from First Visit/Surgery Decision Date to Surgery*			
Mean $\pm$ SD	31.7 $\pm$ 21.9	33.4 $\pm$ 20.7	0.39
Median [IQR]	23 [15 - 48]	29 [18 - 47]	
Days from First Hg to Surgery *			
Mean $\pm$ SD	19.3 $\pm$ 18.9	20.1 $\pm$ 21.8	0.89
Median [IQR]	14 [6 - 30]	14 [6 - 23]	
Hg Closest to Surgery			
Mean $\pm$ SD	104.5 $\pm$ 11.3	132.1 $\pm$ 9.1	<0.0001
Median [IQR]	107 [97 - 113]	131 [124 - 138]	
Nadir Hg (post-op)*			
Mean $\pm$ SD	78.7 $\pm$ 13.7	98.4 $\pm$ 16.5	<0.0001
Median [IQR]	79 [68 - 88]	99 [87 - 110]	
Discharge Hg*			
Mean $\pm$ SD	87.8 $\pm$ 12.8	103.8 $\pm$ 14.1	<0.0001
Median [IQR]	87 [80 - 95]	104 [94 - 113]	
Surgery Time (Minutes) *			
Mean $\pm$ SD	219.5 $\pm$ 121.2	193.3 $\pm$ 80.2	0.23
Median [IQR]	180 [140 - 267]	183 [145 - 225]	
Days from Surgery to Discharge *			
Mean $\pm$ SD	5.8 $\pm$ 3.7	4.6 $\pm$ 3.6	0.0008
Median [IQR]	5 [3 - 7]	4 [3 - 5]	

* Natural log-transformation was applied for normalizing distributions.

preassessment date, occurring at a median of eight days prior to surgery. Rates of iron status assessment with iron studies were low at 11%, although iron deficiency was not detected in the few that did have iron studies.

The rate of preoperative anemia in this cohort was consistent with other studies in gynecological surgical patients (Munoz, Laso-Morales, et al., 2017). Variations may be related to the definition of anemia, especially as guidelines move to define preoperative anemia using the same definition in both

males and females (Butcher et al., 2017; Munoz, Acheson, et al., 2017; Munting & Klein, 2019). In the context of gynecological oncology surgical patients, iron deficiency anemia is quite common (Nelson et al., 2019). Our study was not able to detect the rate of iron deficiency or iron-deficiency anemia because of the low rate of testing during the study period. Iron deficiency has been identified as one of the most common treatable causes of preoperative anemia (Kotze et al., 2015; Lin, 2019) and its assessment is recommended in several guidelines

(Kotze et al., 2015; Munoz, Acheson, et al., 2017). Serum ferritin level is the most sensitive and specific test used for the identification of iron deficiency (Mast et al., 1998). However, in gynecology oncology, inflammation related to malignancy may also be present and assessment of iron status may also require iron studies such as transferrin saturation (Beris et al., 2008). Guidelines suggest that a ferritin of less than 30 mcg/L or a ferritin of less than 100 mcg/L with a transferrin saturation of less than 20% be used in the preoperative setting (Kotze et al., 2015).

Early identification and intervention to treat preoperative iron deficiency anemia in the gynecological surgical patient can greatly influence the trajectory of patient blood management by reducing postoperative transfusions. Opportunities to recognize and treat anemia were present since 50% of patients had more than 28 days between the decision to proceed with surgery and the surgery date. Faulds et al. (2019) reported factors affecting early identification and treatment of preoperative anemia may include the lack of a screening and treatment algorithm, the negative effect on workload for staff, a short period of time for oral iron to be effective, poor availability of outpatient clinics to provide treatment, and the cost of treatment.

Preoperative optimization of anemia in gynecology oncology patients is associated with higher preoperative hemoglobin concentrations and lower risk for transfusion (Beris et al., 2008). Athibovonsuk et al. (2013) explained that intravenous iron transfusions have been shown to be safe in anemic gynecologic cancer patients. Routine assessment for anemia with appropriate bloodwork, including iron studies at the first surgical visit, is a key factor. Ensuring that, detection of anemia occurs as early as possible in the patient's preoperative care is essential and ideally should be done 4-6 weeks prior to surgery. These recommendations are consistent with guidelines aligned with the Enhanced Recovery After Surgery (ERAS) initiative (Nelson et al., 2016; Nelson et al., 2019). ERAS is recognized as a care pathway inclusive of pre-determined activities for specific procedures (in this case gynecology oncology surgery) and were designed to guide care towards the best postoperative outcomes. It is suggested that surgeons should consider preoperative anemia and iron deficiency as an indication for a perioperative care intervention that extends from the decision regarding surgery until complete recovery following the surgical procedure.

In our cohort, 48% of patients had less than 28 days between their initial surgical consultation and the surgery itself and 2% had unknown dates. Thus, another opportunity

for earlier detection of anemia is to include the patient's primary care physician or team. This could be done by creating an algorithm for the primary care providers to follow while awaiting referral, that has specific suggestions for testing (e.g., complete blood counts and ferritin) and when to test (e.g., patients with renal insufficiency, history of anemia or ongoing bleeding). Treating Iron Deficiency Anemia in the gynecological oncology patient population still presents challenges of compliance and efficacy. Patients may only take partial doses of the amount prescribed or may not take the medication on an empty stomach as recommended, ultimately causing hepcidin to block absorption.

Limitations

As this was a retrospective study, various limitations were noted. This is a single-centre study. Laboratory testing results were not available for many patients, as tests were not ordered by the physicians (which constitutes a problem in itself), resulting in missing data. Patients' prognosis and comorbidities were not assessed in the study and, so, there may have been other predictors of transfusion. However, preoperative anemia is one of the only potentially modifiable risk factors for perioperative outcomes (Musallam et al., 2011).

SUMMARY

In summary, there are gaps in the identification and treatment of anemia and iron deficiency anemia in patients undergoing gynecology oncology surgery. This study has demonstrated opportunities for improvement, since patients are assessed with sufficient time in advance of surgery. As one-third of gynecology oncology patients in this study had preoperative anemia, an early diagnostic approach for preoperative anemia and iron deficiency anemia, as part of a patient blood management program, should be a key goal in improving patient outcomes.

ACKNOWLEDGEMENT

We would like to acknowledge Mark Iacovelli and Diane Bentley, blood conservation nurses who worked with the Blood Conservation program. The blood conservation programs is part of the Ontario Nurse Transfusion Coordinators (ONTraC) network. We appreciate Liying Zhang's work for statistical support. Funding for this project was provided by the Practice-Based Research and Innovation Seed Grant Program at Sunnybrook Health Sciences Centre and the University of Toronto Quality in Utilization, Education and Safety in Transfusion Research Program.

REFERENCES

- Athibovonsuk, P., Manchana, T., & Sirisabya, N. (2013). Prevention of blood transfusion with intravenous iron in gynecologic cancer patients receiving platinum-based chemotherapy. *Gynecologic Oncology*, 131(3), 679-682.
- Beris, P., Munoz, M., Garcia-Erce, J. A., Thomas, D., Maniatis, A., & Van der Linden, P. (2008). Perioperative anaemia management: consensus statement on the role of intravenous iron. *Br J Anaesth*, 100(5), 599-604. doi: 10.1093/bja/aen054
- Butcher, A., Richards, T., Stanworth, S. J., & Klein, A. A. (2017). Diagnostic criteria for preoperative anaemia-time to end sex discrimination. *Anaesthesia*, 72(7), 811-814. <https://doi.org/10.1111/anae.13877>
- Clevenger, B., Mallett, S. V., Klein, A. A., & Richards, T. (2015). Patient blood management to reduce surgical risk. *Br J Surg*, 102(11), 1325-1337; discussion 1324. <https://doi.org/10.1002/bjs.9898>

- Delaney, M., Wendel, S., Bercovitz, R. S., Cid, J., Cohn, C., Dunbar, N. M., ... Biomedical Excellence for Safer Transfusion, C. (2016). Transfusion reactions: prevention, diagnosis, and treatment. *Lancet*, 388(10061), 2825-2836. [https://doi.org/10.1016/S0140-6736\(15\)01313-6](https://doi.org/10.1016/S0140-6736(15)01313-6)
- Faulds, J., Whately-Smith, C., & Clarke, K. (2019). Transfusion requirement and length of stay of anaemic surgical patients associated with a patient blood management service: A single-centre retrospective study. *Transfusion Medicine*, 29(5), 311-318.
- Fowler, A. J., Ahmad, T., Phull, M. K., Allard, S., Gillies, M. A., & Pearse, R. M. (2015). Meta-analysis of the association between preoperative anaemia and mortality after surgery. *Br J Surg*, 102(11), 1314-1324. <https://doi.org/10.1002/bjs.9861>
- Freedman, J. (2014). The ONTraC Ontario program in blood conservation. *Transfus Apher Sci*, 50(1), 32-36. <https://doi.org/10.1016/j.transci.2013.12.010>
- Klein, A. A., Collier, T. J., Brar, M. S., Evans, C., Hallward, G., Fletcher, S. N., ... Association of Cardiothoracic, A. (2016). The incidence and importance of anaemia in patients undergoing cardiac surgery in the UK—The first Association of Cardiothoracic Anaesthetists national audit. *Anaesthesia*, 71(6), 627-635. <https://doi.org/10.1111/anae.13423>
- Kotze, A., Harris, A., Baker, C., Iqbal, T., Lavies, N., Richards, T., ... Thomas, D. (2015). British Committee for Standards in Haematology Guidelines on the Identification and Management of Preoperative Anaemia. *Br J Haematol*, 171(3), 322-331. <https://doi.org/10.1111/bjh.13623>
- Lin, Y. (2019). Preoperative anemia-screening clinics. *Hematology Am Soc Hematol Educ Program*, 2019(1), 570-576. <https://doi.org/10.1182/hematology.2019000061>
- Mast, A. E., Blinder, M. A., Gronowski, A. M., Chumley, C., & Scott, M. G. (1998). Clinical utility of the soluble transferrin receptor and comparison with serum ferritin in several populations. *Clin Chem*, 44(1), 45-51.
- Mueller, M. M., Van Remoortel, H., Meybohm, P., Aranko, K., Aubron, C., Burger, R., ... Group, I. P. F. (2019). Patient blood management: Recommendations from the 2018 Frankfurt Consensus Conference. *JAMA*, 321(10), 983-997. <https://doi.org/10.1001/jama.2019.0554>
- Munoz, M., Acheson, A. G., Auerbach, M., Besser, M., Habler, O., Kehlet, H., ... Klein, A. A. (2017). International consensus statement on the peri-operative management of anaemia and iron deficiency. *Anaesthesia*, 72(2), 233-247. <https://doi.org/10.1111/anae.13773>
- Munoz, M., Laso-Morales, M. J., Gomez-Ramirez, S., Cadellas, M., Nunez-Matas, M. J., & Garcia-Erce, J. A. (2017). Preoperative haemoglobin levels and iron status in a large multicentre cohort of patients undergoing major elective surgery. *Anaesthesia*, 72(7), 826-834. <https://doi.org/10.1111/anae.13840>
- Munting, K. E., & Klein, A. A. (2019). Optimisation of preoperative anaemia in patients before elective major surgery—Why, who, when and how? *Anaesthesia*, 74(Suppl 1), 49-57. <https://doi.org/10.1111/anae.14466>
- Musallam, K. M., Tamim, H. M., Richards, T., Spahn, D. R., Rosendaal, F. R., Habbal, A., ... Jamali, F. R. (2011). Preoperative anaemia and postoperative outcomes in non-cardiac surgery: A retrospective cohort study. *Lancet*, 378(9800), 1396-1407. [https://doi.org/10.1016/S0140-6736\(11\)61381-0](https://doi.org/10.1016/S0140-6736(11)61381-0)
- Nelson, G., Altman, A. D., Nick, A., Meyer, L. A., Ramirez, P. T., Ahtari, C., ... Dowdy, S. C. (2016). Guidelines for pre- and intra-operative care in gynecologic/oncology surgery: Enhanced Recovery After Surgery (ERAS(R)) Society recommendations—Part I. *Gynecol Oncol*, 140(2), 313-322. <https://doi.org/10.1016/j.ygyno.2015.11.015>
- Nelson, G., Bakkum-Gamez, J., Kalogera, E., Glaser, G., Altman, A., Meyer, L. A., ... Dowdy, S. C. (2019). Guidelines for perioperative care in gynecologic/oncology: Enhanced Recovery After Surgery (ERAS) Society recommendations-2019 update. *Int J Gynecol Cancer*, 29(4), 651-668. doi: 10.1136/ijgc-2019-000356
- Njolstad, T. S., Engerud, H., Werner, H. M., Salvesen, H. B., & Trovik, J. (2013). Preoperative anemia, leukocytosis and thrombocytosis identify aggressive endometrial carcinomas. *Gynecol Oncol*, 131(2), 410-415. <https://doi.org/10.1016/j.ygyno.2013.08.032>
- Okocha, O., Dand, H., Avram, M. J., & Sweitzer, B. (2020). An effective and efficient testing protocol for diagnosing iron-deficiency anemia preoperatively. *Anesthesiology*, 133(1), 109-118. <https://doi.org/10.1097/ALN.0000000000003263>
- World Health Organization. (2011). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. <https://www.who.int/vmnis/indicators/haemoglobin/en/>