CHANGES IN PACKED CELL VOLUME AFTER GYNAECOLOGICAL SURGERIES: A COMPARISON OF DAY 1 AND DAY 2 VALUES

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ABSTRACT

Background: **Postoperative anaemia is associated with increased postoperative morbidity. The optimal timing for postoperative packed cell volume (PCV) assessment remains unclear and varies across surgical units.**

Objective: **This study compared PCV values on postoperative days 1 and 2 to determine their relationship with the expected postoperative PCV.**

Method: **A cross-sectional study was conducted among patients who had elective gynaecological surgeries at a tertiary Hospital in Southern Nigeria. PCV was measured preoperatively and at 24 and 48 hours postoperatively. Data on intraoperative blood loss, type of surgery, and anaesthesia were recorded.**

Results: **The mean PCV on postoperative day 1 was 30.87 ± 3.85%, while on day 2, it was 30.33 ± 3.70%, with a significant difference (p = 0.005). The expected postoperative PCV was 31.02 ± 2.68%. The difference between day 1 PCV and the expected PCV was not statistically significant (p = 0.682). Similarly, the day 2 PCV was not significantly different from the expected value (p = 0.064).**

Conclusion: **Although a significant decline in PCV occurred between postoperative days 1 and 2, the day 1 PCV was closer to the expected postoperative value. This suggests that day 1 may be a more reliable time for routine PCV monitoring after gynaecological surgeries.**

Keywords: Packed cell volume, Postoperative, Gynaecology, Timing, Haematocrit

INTRODUCTION

Anaemia affects 1.6 billion people worldwide,[1] with higher prevalence in low and middle-income countries.[2] About 313 million surgeries are carried out worldwide each year,[3] and postoperative anaemia complicates 80-90% of major surgeries.[4] The red cell mass of females is reduced compared to males but has comparable amounts of blood loss when undergoing a similar procedure. One-third of all non-pregnant women are anaemic, and about 96% of women have a drop in packed cell volume postoperatively.[1,5,6] Thus, they generally have a higher transfusion rate compared to men.[7]

The cause of postoperative anaemia is multifactorial, including preoperative anaemia, intraoperative blood loss, increased duration of operation, coagulopathy and nutritional deficiencies.[5,6,8] Preoperative anaemia, which is seen in 50% of patients undergoing surgery, can be an independent cause of postoperative anaemia and has been associated with poor surgical outcomes.[9,10] Intraoperative excessive fluid administration can cause dilutional anaemia or worsen pre-existing anaemia.[11,12] The completion of surgery does not imply an end to blood loss. Postoperative blood loss can continue through surgical drains or in the form of reactionary haemorrhage.[13,14] Additionally, smaller body surface area, older age and the presence of some co-morbidities were implicated in its aetiology.[6,15]

Surgery exposes patients to both intraoperative and postoperative stressors. The worries concerning anaemia are related to its negative influence on recovery, rehabilitation, hospital readmission or re-operation, patient well-being, and healthcare costs.[17] Anaemia in the postoperative period is associated with increased morbidity, 90-day and 30-day mortality.[17,18] It also

predisposes to poor wound healing, increased risk of wound breakdown and sepsis, early postoperative myocardial infarction.[19–21] Generally, all categories of anaemia are associated with a prolonged hospital stay, which is worsened by co-morbidities. A unit of red cell transfusion raises an average adult's haemoglobin by approximately 1 g/dL and increases the packed cell volume by about 3%. Similarly, a blood loss of 500 mL results in a 3% decrease in packed cell volume.[22,23]

These complications rationalise the need to identify patients with anaemia in the immediate postoperative period for early intervention. Aside from postoperative packed cell volume, quantification of surgical blood loss can be a good pointer to assess the likelihood of postoperative anaemia. Delayed diagnosis of anaemia can lead to delayed intervention and prolonged hospital stay in a world where early hospital discharge is advocated.[21,24]

There is a paucity of medical literature about the best timing of postoperative packed cell volume following gynaecological surgeries. The existing studies primarily focused on orthopaedic patients, whereas those involving obstetrics and gynaecology were mainly on obstetric patients.

This study aimed to assess if a difference exists between day one and day two packed cell volume. This ultimately will help determine the optimal timing of postoperative packed cell volume estimation following gynaecological surgeries.

METHODS

This was a cross-sectional study carried out on one hundred and twenty-six (126) eligible women who underwent elective major gynaecological surgeries at our facility from March 2022 to September 2022. Exclusion criteria were preoperative anaemia, haemoglobinopathies and coagulation disorders.

Sampling Procedure and Data Collection

The sample size was determined using the formula for the comparison of means at a confidence of 95%. The standard deviation in the difference in packed cell volume on postoperative day (POD) 1 versus POD 2 (4.759-4.414) was 0.345, according to the study by Aworinde *et al.*[25] giving a sample size of 126. A simple random sampling method was employed in the recruitment of participants preoperatively.

The Obstetrics and Gynaecology Department at the University of Port Harcourt Teaching Hospital (UPTH) has five firms, each performing elective surgeries on different weekdays. An average of 32 major surgeries occurs monthly, totalling 224 during the study period. Randomisation was achieved through a computer-generated set of 126 random numbers from 01 to 224, assigning each patient a number based on their order on the operation list.

A proforma was used to collect socio-demographic data, surgery indications, type of surgery, preoperative packed cell volume, anaesthesia type, intraoperative blood loss, and postoperative packed cell volume values. Preoperative samples were collected one day before surgery, and postoperative samples were taken at 24 and 48 hours. All samples (venous blood) were placed in EDTA bottles and analysed within 30 minutes by the same Haematologist using a 24-place Hettich horizontal microhaematocrit centrifuge. A capillary tube was filled three-quarters full with a mixed blood sample, sealed at a 90° angle, and spun at 10,000 rpm for 5 minutes without exceeding 45 degrees. The haematocrit was measured with a microhaematocrit reader and recorded to the nearest whole number.

Surgeries were led by a consultant or senior registrar with a minimum of two years' experience. Blood loss was estimated using the gravimetric method, supplemented by a suction machine for excessive loss. Weighed materials included soaked mops, drapes, and gowns, while floor spills were mopped with pre-weighed pads. A digital scale measured weight differences, with 1 gram equating to 1 ml of blood. Intraoperative blood transfusions were noted and documented.

Calculation of expected packed cell volume value

The amount of blood transfused was subtracted from the estimated blood loss for patients who received blood transfusion intraoperatively and in the immediate postoperative period.

Net blood loss (Y) = Intraoperative blood loss – amount of blood transfused.

Assuming that 500mls of blood loss is equivalent to a packed cell volume decrease of 3%,[23]

Then, 1 ml of blood loss is equivalent to a packed cell volume drop of Y x 3/500(%).

Thus,

Expected packed cell volume value = Preoperative packed cell volume – [3/500 x net blood loss] %.

If, for example, intraoperative blood loss is 800mls and we transfuse 500mls of blood (1 unit of blood), then the net blood loss (Y) is 800 – 500mls = 300mls.

The drop in packed cell volume is 300 x 3/500 = 1.8%

So, if the preoperative packed cell volume was 34%, the expected packed cell volume will be 34 – 1.8 = 32.2%

Data Analysis

Data analysis was conducted using SPSS version 25.0. Descriptive statistics for categorical variables included frequency and percentages, while continuous data were summarised using means and standard deviation (SD). Inferential statistics compared mean postoperative packed cell volume values on day 1 and day 2 using the paired t-test. A paired samples t-test also compared day 1 and day 2 packed cell volume levels with expected values. The chi-square test was used for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical Approval

Approval was obtained from the Research Ethics Committee of UPTH with reference number UPTH/ ADM/90/S II/VOL XI/1215. Written informed consent was obtained from the enrolled participants.

RESULT

A total of 126 participants who had elective gynaecological surgery and met the inclusion criteria were recruited. The socio-demographic data are illustrated in Table 1. The modal age group was 41-50 (42.1%), with a mean age of 40.42 ± 10.51. The mean preoperative packed cell volume was 33.25 ± 2.42.

The most common elective gynaecological surgery was abdominal myomectomy for uterine fibroids, accounting for 54.8% of cases, as in Table 2. An exploratory laparotomy and drainage of abdomino-pelvic abscess was the least surgery performed (0.8%), while surgery for suspected gynaecological malignancies accounted for 7.1%. The type of surgery performed significantly affected the packed cell volume value of both days (p=0.001). The type of anaesthesia used also significantly affected these postoperative packed cell volume values (p=0.023). However, the duration of surgery had no significant effect on the packed cell volume values on both days (p=0.389, p= 0.744).

Table 1: Socio-demographic characteristics of 126 elective gynaecological surgery patients

Variable	Frequency (%)
Age (years) mean ± SD	40.42 ± 10.51
Range (Min, Max)	65 (17, 82)
≤20	2 (1.6)
21-30	12 (9.5)
31-40	51 (40.5)
41-50	53 (42.1)
51-60	1 (0.8)
>60	7 (5.6)
Marital status	
Single	25 (19.8)
Married	97 (77.0)
Widows	4 (3.2)
Educational status	
None	5 (4.0)
Primary	3 (2.4)
Secondary	24 (19.0)
Tertiary	94 (74.6)
Parity	
0	77 (61.1)
1	17 (13.5)
2-4	19 (15.1)
≥5	13 (10.3)

Most surgeries were carried out by consultants (85.7%), and the mean duration of all surgeries was 151.6 ± 61.33 minutes. The mean blood loss during surgery was 658.86 ± 382.35 millilitres. The mean net blood loss was 373.14 ± 224.93 millilitres after considering intraoperative blood transfusion.

On the first and second postoperative days, the mean packed cell volume values (%) were 30.87 ± 3.85 and 30.33 ± 3.69, respectively. The mean expected packed cell volume (PCV) value following surgery was 31.02 ± 2.68%. A statistically significant difference was observed between postoperative day 1 (30.87 ± 3.85%) and postoperative day 2 (30.33 ± 3.70%) PCV values (p = 0.005). When comparing day 1 PCV (30.87 ±

Table 2: Type of elective gynaecological surgery performed on participants (*n=126*)

Type of surgery	Indication	Frequency (%)
Abdominal myomectomy	Fibroid	69 (54.8)
Total abdominal hysterectomy ± BSO	Fibroid	19 (15.1)
	CIN 3	2 (1.6)
Exploratory laparotomy and ovarian cystectomy/oophorectomy	Ovarian mass/accident	15 (11.9)
Staging laparotomy + TAH+ BSO ± lymphadenectomy	ovarian/endometrial malignancy.	9 (7.1)
Vaginal hysterectomy and pelvic floor repair	Uterovaginal prolapse	8 (6.3)
Vesicovaginal fistula repair	Vesicovaginal fistula	3 (2.4)
Exploratory laparotomy and drainage of abscess	Pelvic abdominopelvic abscess.	1 (0.8)

BSO -Bilateral salpingo-oophorectomy, CIN- Cervical intra-epithelia neoplasia, TAH- Total abdominal hysterectomy.

Table 3: Comparison of measured PCV between postoperative days and expected PCV in the postoperative days.

Postoperative day	Packed Cell Volume			
	Mean	SD	Mean difference	P-value
Day 1 and Day 2			0.54 ± 2.13	**0.005***
POD 1 packed cell volume value	30.87	3.85		
POD 2 packed cell volume value	30.33	3.70		
Day 1 and Expected packed cell volume				
POD 1 packed cell volume value	30.87	3.85	-0.15 ± 4.09	0.682
Expected postoperative packed cell volume	31.02	2.68		
Day 2 and the Expected packed cell volume				
POD 2 packed cell volume value	30.33	3.70		
Expected postoperative packed cell volume	31.02	2.68	-0.69 ± 4.14	0.064

**Statistically significant (p<0.05); Paired t-test; POD=postoperative day.*

3.85%) with the expected postoperative PCV (31.02 ± 2.68%), the difference (-0.15 ± 4.09%) was not statistically significant (p = 0.682). Similarly, day 2 PCV (30.33 ± 3.70%) showed a difference of -0.69 ± 4.14% compared to the expected PCV, but this was also not statistically significant (p = 0.064). (Table 3)

DISCUSSION

The findings of this study showed that a significant difference exists between haematocrit levels on postoperative days one and two following major gynaecological procedures. The average haematocrit values obtained on day 1 and day 2 were 30.87% ± 3.85 and 30.33% ± 3.69 (p = 0.005), respectively. Haematocrit on postoperative day 1 (31.02% ± 2.68) was significantly closer to the expected postoperative value than day 2 (p = 0.064) and confirmed that day 1 is the optimal day for routine monitoring (p = 0.682). The results are consistent with previous studies by Khalfauoi *et al.*[26] and Aworinde *et al.*[23], which also reported a significant difference between day 1 and day 2 postoperative haematocrit.Nagra *et al.*[27] defined day 2 and day 3 as 24 hours and 48 hours after surgery, respectively, corresponding to day 1 and 2 in all other studies reviewed in this study. The difference between days 1 and 2 haematocrit levels may be due to combination of factors like the dilution of blood by intravenous fluids during the postoperative period, ongoing blood loss from the wound site, further equilibration of blood after an acute blood loss and at times an inflammatory response to the surgery.

The study also compared the expected haematocrit values generated for each participant to the values on day 1 and day 2 of the postoperative period. Thus, the expected haematocrit value serves as a control to determine which day (day 1vs day 2) should be preferred. This gives a better scientific backing to selecting the preferred day compared to similar studies by Khalfauoi *et al.* and Aworinde *et al.* Although one of the best methods, the gravimetric method may not provide accurate results in determining the exact blood loss. Additionally, getting all the blood from surgical instruments poses a difficult task. Consequently, it may be that this potential underestimation of blood loss at surgery is the reason why the mean expected haematocrit is higher than the mean haematocrit values on day 1 and day 2 in this study.

The analysis from this study identifies postoperative day 1 as the best time to carry out haematocrit after surgery. Hence, this study supports previous studies that recommended routine testing of patients on the first postoperative day. Post-surgery, there can be a significant drop in haematocrit, emphasizing the need for early diagnosis. Surgeons may prompt immediate haematocrit testing or transfusions when clinically evident. However, some cases of anaemia may not be overt, and individual surgeons might have specific haematocrit cut-off values for transfusions, even without clear clinical signs of anaemia.

While this study and that of Khalfauoi *et al.* found a significant difference in the haematocrit of day 1 and day 2, Khalfauoi *et al.* suggested that postoperative haematocrit should be carried out on day 2. Their study was, however, limited by its small number of participants (61), and it was of retrospective design unlike ours, which is prospective. This is the first study exclusively on gynaecological patients. The expected haematocrit value used to determine the best day haematocrit is more scientific than the assumptions from other studies.

CONCLUSION

This study has shown that the mean haematocrit on postoperative day 1 was closer to the mean expected postoperative haematocrit than the mean haematocrit

on postoperative day 2. Thus, the haematocrit should be routinely checked on postoperative day 1. Future studies should validate or refute these results in heterogeneous surgical populations and improve the methods for the estimation of intraoperative blood loss.

Conflict of Interest Statement

The authors affirm that they have no conflict of interests to declare.

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