Original Article

Is Menstruation a Valid Reason to Postpone Cardiac Surgery?

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ABSTRACT

Background: Cancellation of any scheduled surgery is a significant drain on health resources and potentially stressful for patients. It is frequent in menstruating women who are scheduled to undergo open heart surgery (OHS), based on the widespread belief that it increases surgical and menstrual blood loss.

Aims: The aim of this study was to evaluate blood loss in women undergoing OHS during menstruation.

Settings and Design: A prospective, matched case-control study which included sixty women of reproductive age group undergoing OHS.

Patients and Methods: The surgical blood loss was compared between women who were menstruating (group-M; *n* = 25) and their matched controls, i.e., women who were not menstruating (group-NM; *n* = 25) at the time of OHS. Of the women in group M, the menstrual blood loss during preoperative (subgroup-P) and perioperative period (subgroup-PO) was compared to determine the effect of OHS on menstrual blood loss.

Results: The surgical blood loss was comparable among women in both groups irrespective of ongoing menstruation (gr-M = 245.6 ± 120.1 ml vs gr-NM = 243.6 ± 129.9 ml, *P* value = 0.83). The menstrual blood loss was comparable between preoperative and perioperative period in terms of total menstrual blood loss (gr-P = 36.8 ± 4.8 ml vs gr-PO = 37.7 ± 5.0 ml, *P* value = 0.08) and duration of menstruation (gr-P = 4.2 ± 0.6 days vs gr-PO = 4.4 ± 0.6 days, *P* value = 0.10).

Conclusion: Neither the surgical blood loss nor the menstrual blood loss is increased in women undergoing OHS during menstruation.

Keywords: Cardiac surgery, cardiopulmonary bypass, menstruation, menstrual blood loss, surgical blood loss

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INTRODUCTION

Cancellation of any scheduled surgery is a distressing event having financial implications and emotional consequences.[1,2] It is not only a waste of resources in terms of inefficient use of operating-theatre time, staff morale, hospital patient relationships but also potentially stressful for patients due to working days forfeited and hampering of routine life. High level of emotional involvement in the surgery leading to depression following the cancellation of surgery has been reported.[3] Previous reports evaluating delisting of elective procedures among various surgical subspecialties have published cancellation rates of 15% to 24% for cardiothoracic and vascular surgical procedures.[4,5] Smith *et al*.[6] retrospectively reviewed the same day cancellation rate of cardiac surgeries and report it to be 2%. The causes were foreseeable (17%), non-foreseeable (59%),

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and indeterminate cancellation (24%) and it comprised of medical reasons (51%), administrative factors (17%), procedure no more indicated (11%), patient-related factors (6%), preoperative complications (3%) and unknown causes (12%).

Solak *et al*.[7] evaluated the causes behind cancellation of elective surgeries (out of 8201surgeries) at General Hospital in Sarajevo and reported the prevalence of delisting on the same day of surgery as 4.58% (around 376 cases). The most common reasons were lack of operating room time (33.51%), medical reasons (31.38%), or cancellation by the surgeon (11.97%). The surgical reasons were mostly due to inadequate indication for surgeries or the onset of menstruation in women.

Yu *et al*.[8] retrospectively reviewed 11,331 elective surgeries and found 746 cases were cancelled. The causes for cancellation were categorized into six broad categories, comprising preoperative issues (25.8%), coordination impediments (15.1%), patient-related causes (13.0%), administrative or scheduling error (11.8%), doctor related (8.5%), and non-specified reasons (25.8%). The cancellation rate among females was higher (18.3%) as compared to males (16.7%). They also concluded that a considerable number of cancellations among female patients were due to onset of menstruation.

At our institute, the cancellation rate of elective cardiac surgery among female patients due to menstruation is 10 to 15%. There is a general belief, even among healthcare professionals, that menstruation is a relative contraindication for elective surgery.[9] This is attributed to compromised sanitation and hygiene, the functional impairment of the coagulation system,[10] accompanying postoperative nausea and vomiting (PONV)[11] and pain[12] which may interfere with the general picture, and therefore, hinder the recognition of postoperative complications.

The physiological trespass is maximum in cardiac surgery influencing all organ systems due to use of extracorporeal circuitry. Blood loss is even more relevant during cardiac surgery than in other forms of surgery, as patients are anticoagulated during surgery. Cardiopulmonary bypass (CPB) itself impairs hemostasis, reduces platelet count and function, affects coagulation factors and also activates fibrinolysis.[13] In addition, hypothermia during the conduct of CPB detrimentally affects the hemostatic process. Moreover, women with heart disease have a more labile hemodynamic system compounded by one or more of the following factors: congenital malformations, rhythm disturbances, valvular abnormalities, pulmonary hypertension, systemic venous congestion, and use of cardiovascular medications.[14]

There is limited description in the literature about surgical and menstrual blood loss in cardiac surgical procedures conducted during the course of menstruation. Therefore, the present study was conceptualized with the aim to evaluate blood loss in women undergoing open heart surgery (OHS) during menstruation. The primary objective was to compare the surgical blood loss among women undergoing OHS during menstruation and the secondary objective was to compare the menstrual blood loss between the preoperative and perioperative period.

PATIENTS AND METHODS

This was a single center, prospective matched case-control study conducted at a tertiary care referral cardiac center. The study protocol was approved by the Institute Ethics Committee (IECPG-259/22.04.2019).

The protocol was explained to the participants and written informed consent was taken. Women aged 20-40 years, ASA II and III, with regular menstrual cycles were included in the study group; whereas pregnant women, lactating mothers, patients with history of bleeding or coagulation abnormalities, women with irregular or excessive menstrual bleeding, women taking oral contraceptive pills or having intrauterine device *in situ* and patients undergoing emergency surgery were excluded from the study.

Thirty-five women were initially recruited. Eight women were excluded at the enrollment phase owing to menstrual irregularities and two were excluded during follow-up, hence 25 women were included as subjects (group M). Twenty-five women who were not menstruating at the time of surgery were matched individually to the subjects according to the planned surgical procedure, were enrolled as controls (group-NM). The patient distribution and allocation are outlined in the consort flow diagram [Figure 1].

The enrolled women were assessed for their menstrual cycle as per the menstrual questionnaire[15] and gynecological clearance obtained. After counselling and educating the patients regarding menstrual blood loss, they assessed the preoperative cycle themselves at home as per menstrual pictogram [Figure 2] developed by Wyatt KM *et al*.[16] The sensitivity and specificity of menstrual pictogram is reported to be 96% and 92%, respectively.[17]

All patients were asked to report for hospital admission a day prior to the expected date of menstruation and

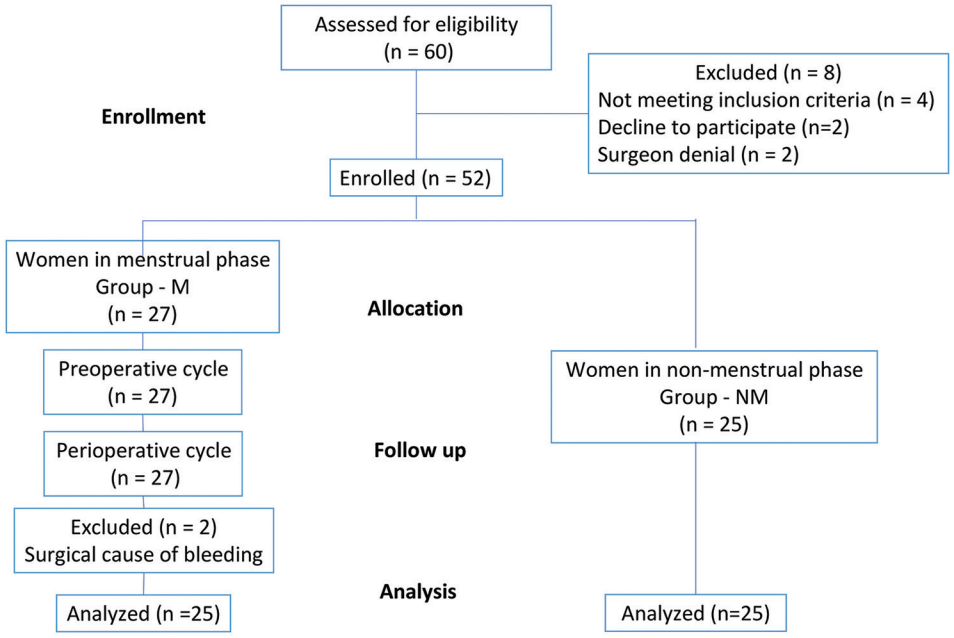

Figure 1: Consort flow diagram

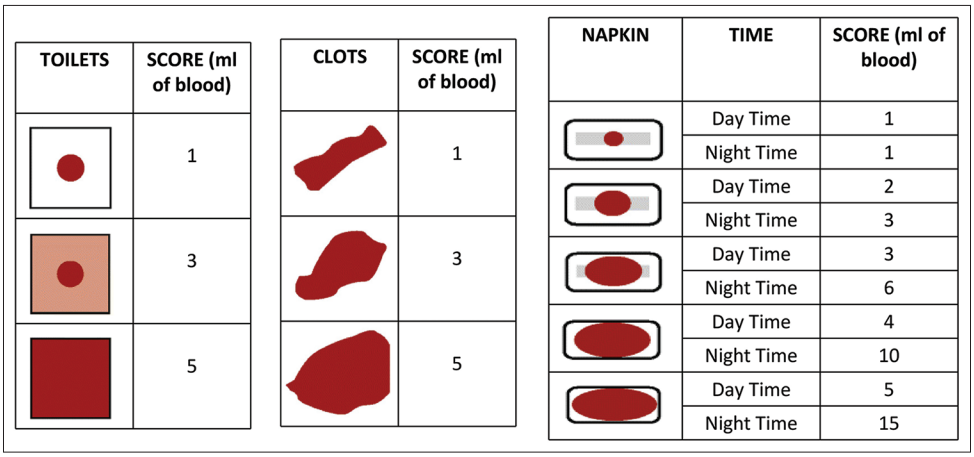

Figure 2: Menstrual Pictogram

were scheduled for surgery on the earliest available slot after menstruation commenced. The anaesthetic, surgical, CPB and postoperative management were as per standard institutional protocols.

Postoperative surgical blood loss was assessed by daily drain output, requirement for re-exploration, use of blood and blood products and daily hematocrit estimation. The attending nurse was briefed about menstrual pictogram beforehand. Menstrual blood loss was assessed by the attending nurse in the postoperative period in terms of total menstrual blood loss and length of menstrual cycle. Every time it was also cross checked by the primary investigator. However, after extubation, the patient estimated the menstrual blood loss which was cross checked by the primary investigator.

A minimum hematocrit of 30 was maintained throughout the perioperative period.

Statistical analysis

Due to paucity in literature regarding surgical and menstrual blood loss during perioperative period in women undergoing cardiac surgery, we aimed to conduct a preliminary study including 25 women during ongoing menstruation (subjects) and 25 matched controls. Therefore, the total sample size was 50 women of reproductive age group.

Quantitative data were expressed as mean ± SD or median (min-max) whereas qualitative data was expressed as proportion or number as appropriate. Paired t-test was

used to observe the mean blood loss as well as length of menstrual cycle between preoperative and perioperative cycle. For comparison of surgical blood loss between women in menstrual phase & non-menstrual phase paired t-test was applied. The data were processed using STATA software, version 16 (Stata Corp LP, College Station, TX). A *P* value <0.05 was considered to be statistically significant.

RESULTS

The groups M and NM were comparable with regards to the demographic, coagulation and menstrual parameters. [Table 1] The surgical parameters were comparable in both groups [Table 2].

The postoperative surgical blood loss is depicted in Table 3. It is noteworthy that the surgical drain output in group-M was 245.6 ± 120.1ml (range 80-330 ml) and group-NM was 243.6 ± 129.9 ml (range 150–340 mL), which was statistically not significant (*P* = 0.83). The postoperative transfusion requirement in the form of packed red blood cells (PRBC), platelet concentrate (PC) and fresh frozen plasma (FFP) were comparable among the matched pairs.

In group-M, the menstrual blood loss was assessed preoperatively (subgroup- P) and perioperatively (subgroup-PO) [Table 4]. The total menstrual blood loss was 36.8 ± 4.8 ml (range 30-48 ml) during preoperative cycle whereas 37.7 ± 5.0 ml (range 30-49 ml) during perioperative cycle. The duration of menstruation was 4.2 ± 0.6 days and 4.4 ± 0.6 days in subgroup-P and subgroup-PO, respectively. The menstrual blood loss was not significant either in terms of blood loss (*P* value = 0.08) or duration of menstruation (*P* value = 0.10).

Table 1: Preoperative variables.

Variables	Group- M Mean±SD (*n*=25)	Group - NM Mean±SD (*n*=25)	Level of significance (*P*)
Demographic parameters			
Age (years)	29.4±6.6	30.9±7.5	0.10
Height (cm)	155.2±5.7	155.0±7.1	0.91
Weight (Kg)	52.3±9.5	52.7±11.5	0.82
BMI (Kg/m^2)	21.6±3.1	21.7±3.6	0.84
Hemoglobin (mg/dl)	12.8±2.5	13.4±2.4	0.06
Hematocrit (%)	38.5±8.9	40.3±8.9	0.06
Coagulation parameters			
Platelet count (lakhs/dl)	1.6±0.4	1.6±0.7	0.89
ACT (sec)	147.4±14.7	150.5±13.1	0.40
PT (sec)	12.7±1.3	12.6±1.2	0.57
aPTT (sec)	30.4±3.9	31.5±3.2	0.06
INR	1.1±0.1	1.2±0.1	0.71
Fibrinogen level (mg/dl)	211.1±45.4	205.5±53.1	0.41
Menstrual parameters			
Age of menarche (years)	13.2±0.8	13.5±0.9	0.06
Menstrual cycle (days)	29.2±1.4	29.1±1.5	0.85
Duration of menstruation (days)	4.2±0.7	4.4±0.6	0.33

BMI, body mass index; ACT, activated clotting time; PT, prothrombin time; aPTT, activated plasma thromboplastin time; INR, international normalized ratio

Table 2: Operative variables

	Group- M Mean±SD (*n*=25)	Group- NM Mean±SD (*n*=25)	Level of significance (*P*)
Surgical parameters:			
Duration of surgery (min)	233.7±65.9	223.4±76.6	0.14
CPB time (min)	103.2±39.7	94.1±36.3	0.07
AoXCl time (min)	68.2±31.2	59.6±30.2	0.08
Lowest temp (°C)	30.8±2.4	31.3±2.2	0.09
Type of Surgeries:			
ASD closure	5	5	-
VSD closure	1	1	-
MVR	5	5	-
AVR	3	3	-
DVR	2	2	-
Redo MVR	2	2	-
LA Myxoma excision	1	1	-
MICS (ASD closure)	1	1	-
Bentall procedure	1	1	-
BD Glenn + Atrial septectomy	1	1	-
MV repair	1	1	-
Intracardiac repair for TOF	1	1	-
VSD closure + pulmonary valvotomy	1	1	-

CPB, cardiopulmonary bypass; AoXCl, aortic cross clamp; temp, temperature; ASD, atrial septal defect; VSD, ventricular septal defect; MVR, mitral valve replacement; AVR, aortic valve replacement; DVR, double valve replacement; LA, left atrium; MICS, minimally invasive cardiac surgery; BD, bidirectional; MV, mitral valve; TOF, tetralogy of Fallot

DISCUSSION

Menstruation is a physiological phenomenon of periodic endometrial exfoliation which is caused by cyclical switch of sex hormones (estrogen and progesterone) controlled by the mutual feedback between the hypothalamus, the anterior pituitary gland, and the gonads.[10] However, coagulation pathway especially the extrinsic pathway plays a role as thrombin-induced fibrin generation is stimulated in the endometrium by tissue factor. Tissue factor levels in decidualized endometrial cells rise under the influence of progesterone and decline due to progesterone withdrawal.[18]

Menstrual cycle causes cyclic changes in hormonally-sensitive organs, such as mammary glands, uterus, vagina, conjunctiva, oral mucosa and Eustachian tube. Therefore, surgical procedures during menstruation involving hormone-dependent organs causes increased blood loss.[19-21] Certain studies claim that the menstrual cycle also influences blood loss during surgeries on hormone independent organs like abdominoplasty, and middle ear surgeries.[22,23]

Table 3: The comparison of postoperative surgical blood loss and transfusion requirement

Postoperative variables	Group - M Mean±SD (*n*=25)	Group – NM Mean±SD (*n*=25)	Level of significance (*P*)
Surgical drain output (ml)	245.6±120.1 (80-330)	243.6±129.9 (150-340)	0.83
Surgical drain output (ml/kg)	4.8±2.6	4.9±3.1	0.52
PRBC transfusion (ml)	360±126.5	370±151.3	0.83
PC transfusion (ml)	88.5±21.9	76.9±25.9	0.08
FFP transfusion (ml)	214.3±77.0	182.1±63.9	0.08
Hematocrit (%)	34.2±2.1	35.0±2.5	0.09

PRBC, packed red blood cells; PC, platelet concentrate; FFP, fresh frozen plasma

Table 4: The comparison of preoperative and perioperative menstrual blood loss in Group-M

	Group- P Mean±SD (*n*=25)	Group-PO Mean±SD (*n*=25)	Level of Significance (*P*)
Total Menstrual blood loss (ml)	36.8±4.8 (30-48)	37.7±5.0 (30-49)	0.08
Duration of menstruation (days)	4.2±0.6 (3-5)	4.4±0.6 (3-5)	0.10

Group- P as preoperative cycle and Group-PO as perioperative cycle

Findikcioglu *et al*.[19] summarized the effect of menstruation on intraoperative bleeding in 107 patients who underwent rhinoplasty surgery. The mean intraoperative blood loss was 69.0 ± 24.6 ml in perimenstrual and 80.4 ± 27.7 ml in periovulatory group which was statistically significant. They deduced that, though perioperative blood loss was higher during periovulatory phase, but it had no impact on the outcome.

There is change of adipose tissue thickness in the subcutaneous plane during the phases of menstrual cycle. Though abdomen constitutes the major bulk of subcutaneous adipocytes, but this region was not directly influenced by acute hormonal changes of menstrual cycle. Findikcioglu *et al*.[22] illustrated the impact of different phases of menstrual cycle on intraoperative as well as postoperative bleeding in abdominoplasty surgeries and showed no significant difference with regards to intra-operative and post-operative blood loss.

Zhong Lin *et al*.[24] examined blood loss in patients undergoing vitreoretinal surgery during the perimenstrual phase (n = 69) and periovulatory phase (n = 86). They inferred that the phases of menstrual period do not in any way affect perioperative bleeding therefore, menstruation should not be a contraindication for vitreoretinal surgery.

The cardiovascular system is also influenced with hormonal changes of menstrual cycle. Lutsenko evaluated the influence of different phases of ovarian-menstrual cycle on cardiovascular physiology. Higher heart rate was noted during ovulation phase due to the effect of estrogen.[25] It was claimed that spontaneous baroreflex sensitivity decreased during the follicular phase as compared to the luteal phase. During luteal phase, the heart rate and systolic blood pressure were elevated with a lower diastolic blood pressure as a result of higher sympathetic activity and estrogen induced nitric oxide production.[26] The physiological as well as the psychological stress response to hemodynamic stimuli was also heightened.[27] Rosano *et al*.[28] noted a higher incidence of arrhythmias particularly paroxysmal supraventricular tachycardia in the menstrual phase than during the follicular phase.

Hua Lin and Wen-zhi Li[29] studied the impact of menstrual cycle on circulation during combined spinal epidural anesthesia (CSEA). They selected 46 women undergoing gynecological surgery and categorized them according to follicular phase and luteal phase. They deduced that the heart rates among corpus luteal phase group were significantly higher than the follicular phase group both before and after anesthesia and therefore, patients of corpus luteal phase group required significantly more ephedrine during the first thirty minutes following CSEA.

Hjortdal *et al*.[30] compared blood loss among women (n = 22) and men (n = 22) undergoing OHS and found that the mean postoperative blood loss in the first 24 hours was 312 ml (range 50–1442 ml) and 331 ml (range 160–796 ml), respectively which was not statistically significant. Unplanned menstrual bleeding was detected in 13 (60%) women. Some had early onset and some had late onset; however, none had abnormally increased or prolonged menstruation. They concluded that the menstrual bleeding pattern was disturbed by OHS but it did not affect surgical bleeding.

The present study was conducted to evaluate blood loss in women undergoing OHS during ongoing menstruation. Secondly, this study included estimation of surgical as well as menstrual blood loss during the perioperative period and notably, neither the surgical blood loss nor the menstrual blood loss was affected during the conduct of cardiac surgery [Figure 3].

The research incorporated an extended spectrum of operative procedures ranging from simple congenital heart surgeries, complex surgeries for cyanotic heart disease, valvular procedures, redo surgeries, cardiac tumors, major vascular surgeries and minimally invasive surgeries. Patients with cyanotic heart disease have inherent coagulation

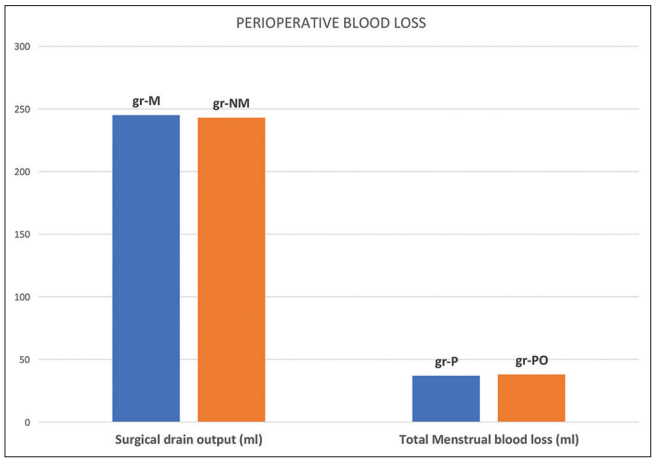

Figure 3: Perioperative blood loss. gr-M, menstruating women; gr- NM, non-menstruating women; gr- P, preoperative cycle; gr-PO, perioperative cycle

abnormalities,[14] correspondingly patients undergoing redo surgeries and surgeries involving major vascular structures have an acquired hemostatic defect. The present study included 2 redo mitral valve replacement cases. They underwent mitral valve repair previously and were not receiving any anticoagulants preoperatively. In spite of the diverse set of surgeries, the postoperative surgical blood loss and transfusion requirement were proportionate. Postoperatively, two patients who had undergone valve replacement required re-exploration for surgical cause of bleeding. Hence, both these patients were excluded from the final analysis.

The average menstrual blood loss is 35–50 ml, lacking significant clots.[16] Heavy menstrual bleeding is defined as bleeding for more than seven days or measured blood loss of more than 80 ml.[16] In the present study, the baseline preoperative menstrual blood loss was calculated and correlated with menstrual blood loss in the perioperative setting in order to evaluate whether the anticoagulation used, conduct of CPB, hypothermia, altered homeostasis during cardiac surgery affect the menstrual blood loss. The perioperative menstrual blood loss was not increased in the terms of amount of blood loss and duration of menstruation as compared to the baseline menstrual parameters. In the perioperative cycle, the menstrual blood loss ranged from 30-49 ml and duration ranged from 3-5 days which was within the normal range. Heart valve replacement with mechanical prosthesis mandates use of oral anticoagulants to mitigate thrombotic complications. Fourteen women in group M required warfarin anticoagulation postoperatively following aortic valve replacement, mitral valve replacement (MVR), double valve replacement, redo MVR, mitral valve repair or Bentall procedure. They apprised the authors regarding subjective 'thinness of blood' and 'reduced clot expulsion'. Interestingly, the duration of menstruation was similar to preoperative cycle.

There were a few limitations of the study. First, the sample size was relatively small. Secondly, although the commonly performed cardiac surgeries were well represented in the present study, but emergency surgeries/surgeries performed on deep hypothermic circulatory arrest/off-pump cardiac surgeries were not included. Lastly, we did not objectively study the postoperative effect of warfarin on menstrual blood loss in subsequent cycles.

In summary, the present study sought the scientific truth behind the belief that 'surgery during menstruation entails excessive blood loss'. It was inferred that neither the surgical blood loss nor the menstrual blood loss was increased in women undergoing open cardiac surgery during menstruation. The authors wish to dispel the age-old adage that elective surgery during menstruation is associated with excessive blood loss.

CONCLUSION

Neither the surgical blood loss nor the menstrual blood loss is increased in women undergoing cardiac surgery during menstruation. Therefore, menstruation should not be considered as a valid reason to postpone cardiac surgery.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Argo JL, Vick CC, Graham LA, Itani KM, Bishop MJ, Hawn MT. Elective surgical case cancellation in the veterans' health administration system: Identifying areas for improvement. Am J Surg 2009;198:600-6.
2. Ivarsson B, Larsson S, Sjöberg T. Postponed or cancelled heart operations from the patient's perspective. J Nurs Manag 2004;12:28-36.
3. Viftrup A, Dreyer P, Nikolajsen L, Holm A. Surgery cancellation: A scoping review of patients' experiences. J Clin Nurs 2021;30:357-71.
4. Farasatkish R, Aghdaii N, Azarfarin R, Yazdanian F. Can preoperative anesthesia consultation clinic help to reduce operating room

cancellation rate of cardiac surgery on the day of surgery? Middle East J Anaesthesiol 2009;20:93-6.
5. Schofield WN, Rubin GL, Piza M, Lai YY, Sindhusake D, Fearnside MR, *et al*. Cancellation of operations on the day of intended surgery at a major Australian referral hospital. Med J Aust 2005;182:612-5.
6. Smith MM, Mauermann WJ, Cook DJ, Hyder JA, Dearani JA, Barbara DW. Same-day cancellation of cardiac surgery: A retrospective review at a large academic tertiary referral center. J Thorac Cardiovasc Surg 2014;148:721-5.
7. Solak AK, Pandza H, Beciragic E, Husic A, Tursunovic I, Djozic H. Elective case cancellation on the day of surgery at a general hospital in sarajevo: Causes and possible solutions. Mater Sociomed 2019;31:49-52.
8. Yu K, Xie X, Luo L, Gong R. Contributing factors of elective surgical case cancellation: A retrospective cross-sectional study at a single-site hospital. BMC Surg 2017;17:100.
9. Kenig J, Richter P, Sikora Ł. Menstruation--still a contraindication to elective surgery? Pol Przegl Chir 2014;86:57-9.
10. Knol HM, Kemperman RF, Kluin-Nelemans HC, Mulder AB, Meijer K. Haemostatic variables during normal menstrual cycle. A systematic review. Thromb Haemost 2012;107:22-9.
11. Šimurina T, Mraovic B, Skitarelić N, Andabaka T, Sonicki Z. Influence of the menstrual cycle on the incidence of nausea and vomiting after laparoscopic gynecological surgery: A pilot study. J Clin Anesth 2012;24:185-92.
12. Ahmed A, Khan F, Ali M, Haqnawaz F, Hussain A, Azam SI. Effect of the menstrual cycle phase on post-operative pain perception and analgesic requirements. Acta Anaesthesiol Scand 2012;56:629-35.
13. Levy JH. The effects of cardiopulmonary bypass on coagulation. Clin Adv Hematol Oncol 2013;11:589-91.
14. Canobbio MM, Perloff JK, Rapkin AJ. Gynecological health of females with congenital heart disease. Int J Cardiol 2005;98:379-87.
15. Matteson KA, Scott DM, Raker CA, Clark MA. The menstrual bleeding questionnaire: Development and validation of a comprehensive patient-reported outcome instrument for heavy menstrual bleeding. BJOG 2015;122:681-9.
16. Wyatt KM, Dimmock PW, Walker TJ, O'Brien PM. Determination of total menstrual blood loss. Fertil Steril 2001;76:125-31.
17. Larsen L, Coyne K, Chwalisz K. Validation of the menstrual pictogram in women with leiomyomata associated with heavy menstrual bleeding. Reprod Sci 2013;20:680-7.
18. Lockwood CJ, Runic R, Wan L, Krikun G, Demopolous R, Schatz F. The role of tissue factor in regulating endometrial haemostasis: Implications for progestin-only contraception. Hum Reprod 2000;15(Suppl 3):144-51.
19. Findikcioglu K, Findikcioglu F, Demirtas Y, Yavuzer R, Ahyan S, Atabay K, *et al*. Effect of the menstrual cycle on intraoperative bleeding in rhinoplasty patients. Eur J Plast Surg 2009;32:77-81.
20. Hrushesky WJ, Bluming AZ, Gruber SA, Sothern RB. Menstrual influence on surgical cure of breast cancer. Lancet 1989;2:949-52.
21. Baron DA, Hardie T, Leventhal JL, Della Badia CR. Timing of hysterectomy surgery during the menstrual cycle--impact of menstrual cycle phase on rate of complications: Preliminary study. J Am Osteopath Assoc 1999;99:25-7.
22. Findikcioglu K, Findikcioglu F, Sezgin B, Demirtas Y, Yavuzer R. The impact of the menstrual cycle on intra-operative and postoperative bleeding in abdominoplasty patients. J Plast Reconstr Aesthet Surg 2012;65:e338-43.
23. Honkavaara P, Pyykkö I, Rutanen EM. Increased incidence of retching and vomiting during periovulatory phase after middle ear surgery. Can J Anaesth 1996;43:1108-14.
24. Lin Z, Moonasar N, Wu RH, Seemongal-Dass RR. The impact of the menstrual cycle on perioperative bleeding in vitreoretinal surgery. J Ophthalmol 2017;2017:9549284.
25. Lutsenko O. Functioning of the cardiovascular system of women in different phases of the ovarian-menstrual Cycle, Highlights on Hemodynamics, IntechOpen. 2018. doi: 10.5772/intechopen.79633.
26. Kurdi MS, Ramaswamy AH. Does the phase of the menstrual cycle really matter to anaesthesia? Indian J Anaesth 2018;62:330-6.
27. Manhem K, Jern C, Pilhall M, Shanks G, Jern S. Haemodynamic responses to psychosocial stress during the menstrual cycle. Clin Sci (Lond) 1991;81:17-22.
28. Rosano GM, Leonardo F, Sarrel PM, Beale CM, De Luca F, Collins P. Cyclical variation in paroxysmal supraventricular tachycardia in women. Lancet 1996;347:786-8.
29. Lin H, Li WZ. Effect of the menstrual cycle on circulation during combined spinal-epidural anaesthesia. BMC Anesthesiol 2018;18:109.
30. Hjortdal VE, Larsen SH, Wilkens H, Jakobsen A, Pedersen TA. Menstrual bleeding after cardiac surgery. Eur J Cardiothorac Surg 2014;45:171-3.