Original Article

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Evaluation of the Modified Caprini Risk Score in Benign Gynecological Surgery: is Routine Prophylaxis Necessary?

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ABSTRACT

Purpose: Deep vein thrombosis (DVT) and venous thromboembolism represent major causes of postoperative morbidity and mortality in gynecological surgical practice. The aim of this study was to evaluate the incidence of DVT among patients undergoing benign gynecological procedures, identify relevant risk factors, assess the utility of the modified Caprini risk assessment model, and examine the effectiveness of thromboprophylaxis strategies.

Methods: The modified Caprini risk score was used to evaluate DVT risk. Demographic characteristics, body mass index, hormonal therapy use, operative details, postoperative mobilization time, and thromboprophylaxis data were collected. Then, the incidence rates of DVT were compared between the group of patients receiving prophylactic anticoagulation and those not receiving it. All statistical analysis was performed using SPSS 15.0 (IBM İnc., Armonk, NY, USA), and categorical and continuous variables were analyzed using appropriate parametric and non-parametric tests, with a $p<0.05$ considered statistically significant.

Results: A majority (84.3%) of the 172 patients included were classified as high- or very-high-risk according to the modified Caprini model. Overweight and obesity were common (35.7% and 29.7%, respectively). Low-molecular-weight heaprin (LMWH) prophylaxis was administered to 55% of patients. Only one patient (0.58%) developed DVT. No significant difference in DVT incidence was found between those who received LMWH and those who did not. Mechanical prophylaxis was not applied in any patient, yet no DVT occurred in the moderate-risk group.

Conclusion: The modified Caprini score may overestimate risk in this population. Gynecology-specific risk assessment tools are needed.

Keywords: Deep vein thrombosis, low-molecular-weight heparin, modified Caprini risk scoring system

Introduction

Deep vein thrombosis (DVT) is a serious postoperative complication[1,2] and a key component of venous thromboembolism (VTE), which accounts for approximately 10% of all hospital deaths and also significantly contributes to morbidity and mortality in postsurgical patients.[3,4] The pathophysiology of DVT is classically explained by Virchow's triad, which encompasses venous stasis, endothelial injury, and a hypercoagulable state. These are three interrelated processes that collectively facilitate thrombus formation within the venous system. Most patients undergoing gynecological surgery are in the peri- or postmenopausal period, during which age-related physiological changes, hormonal alterations, and the higher prevalence of comorbid conditions collectively contribute to a prothrombotic state and altered coagulation dynamics.[5] In addition, a substantial proportion of gynecological procedures performed in women of reproductive age are indicated for benign yet clinically significant conditions, such as uterine fibroids and endometriosis.[6] Although minimally invasive approaches are increasingly preferred in gynecological surgery, open surgical techniques remain necessary. Factors such as large uterine size, multiple or deeply located leiomyomas, severe endometriosis, dense

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pelvic adhesions from previous surgeries, and anatomical limitations may prevent the use of laparoscopic or vaginal methods.[7] As a result, laparotomy for benign reasons continues to be performed routinely in certain patients. Such surgeries may further compromise venous return in the pelvic vasculature and accentuate venous stasis by prolonging postoperative immobility.[8] Prolonged postoperative immobility has been identified as a major contributor to thrombus development, as demonstrated by Qu et al.,[9] while Suzuki et al.[10] similarly reported that the incidence of VTE increases with the accumulation of risk factors associated with stasis. Endothelial damage, by releasing subendothelial collagen and tissue factor, activates platelets and initiates the coagulation cascade, thus further increasing thrombogenic susceptibility, a mechanism highlighted by Peedicayil et al.[11] in the context of gynecological malignancy and open invasive procedures. Finally, a hypercoagulable state, whether inherited or acquired, may contributes to Virchow's triad. This hypercoagulopathic state may be due to various strong prothrombotic stimuli, such as malignancy, hormonal changes, emergency surgery, or thrombophilia.[12-15] Consequently, these hemodynamic and physiological perturbations collectively heighten the susceptibility to postoperative thromboembolic events in this population.

The incidence of DVT varies significantly across gynecological surgical populations and is much higher among patients with gynecological malignancies. While the reported rate of perioperative DVT in benign gynecological surgery ranges from approximately 6.2% to 29.1%, this risk rises to 19.6-38% in patients undergoing surgery for gynecological cancers.[16,17] The modified Caprini risk assessment model is one of the most widely used and guideline-endorsed tools for perioperative VTE risk stratification. It is recommended by international guidelines, including those of the American College of Chest Physicians, and has been validated across multiple surgical disciplines.[18,19] According to the modified Caprini risk assessment model, the estimated incidence of VTE in surgical patients varies by risk category, ranging from <0.5% in low-risk, 1.5% in moderate-risk, 3% in high-risk, and up to 6% in very-high-risk groups.[20] Thromboprophylaxis should therefore be tailored to individual risk status. Low-risk patients generally require only early mobilization and adequate hydration, without the need for mechanical or pharmacologic prophylaxis. In moderate-risk patients, mechanical methods, particularly intermittent pneumatic compression, are recommended as first-line prevention. High-risk individuals require assessment of bleeding risk prior to selecting therapy; mechanical methods are preferred when bleeding risk is elevated, whereas low-molecular-weight heparin (LMWH) or low-dose unfractionated heparin is recommended when bleeding risk is low. In very-high-risk patients, pharmacologic prophylaxis is prioritized, with mechanical methods added when necessary. Extended prophylaxis, up to four weeks, is advised, particularly for patients undergoing surgery for abdominal or pelvic malignancies.[20] Although malignancy-related surgical procedures consistently show a higher incidence of thromboembolic complications than benign gynecological surgeries, it is important to recognize that the perioperative period and especially the first 72 hours after surgery, is the most vulnerable time for thrombus formation, regardless of the underlying condition.[10,16]

This heightened risk highlights the importance of employing structured, evidence-based risk stratification strategies in all women undergoing gynecological procedures. Accordingly, we applied the modified Caprini risk assessment model to systematically evaluate VTE susceptibility in our patient population and aimed to investigate the applicability, predictive value, and clinical relevance of this scoring system in estimating postoperative VTE incidence.

METHODS

All procedures in this study were conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments, or to similar ethical standards. The reviewed and approved this study University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital Local Ethics Committee (approval no: 21, date: 26.01.2017). This retrospective cross-sectional study included patients who underwent open abdominal or laparoscopic surgery for benign gynecological indications at the Department of Obstetrics and Gynecology of University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospitalin 2017. The modified Caprini risk assessment model (Table 1) was employed to stratify preoperative DVT risk. Women aged 18 years and older who presented to the outpatient clinics of the same department and subsequently underwent open abdominal or laparoscopic pelvic surgery, as well as vaginal hysterectomy for benign gynecological conditions, were eligible for inclusion. Patients who underwent vaginal repair procedures, diagnostic hysteroscopy, transobturator tape or mini-transobturator tape operations were excluded because of short operative times and rapid mobilization, those who had Cesarean delivery, patients operated on for gynecological malignancies, individuals receiving antiplatelet or anticoagulant therapy for chronic medical conditions, and patients whose surgeries had been performed less than one month prior were excluded from the study. Patients included in the study were contacted individually using the telephone numbers registered in the hospital's electronic archive system and were interviewed regarding oral contraceptive use, any prior DVT events, and postoperative thromboprophylaxis practices. Patients who could not be reached or who declined to participate were also excluded. Body mass index (BMI), the presence of pre-existing chronic diseases, the presence of risk factors included in the modified Caprini score, administration of thromboprophylaxis and, when applicable. The duration and dosage of prophylaxis were obtained from the hospital's electronic archive system. Then, all patients were categorized into low (0-1 score), moderate (2 score), high (3-4 score), and very high-risk groups (5 score and above) based on the modified Caprini risk score and a comparison was made between the two groups: one group receiving thrombophylaxis, and one not receiving it, in order to assess the occurrence of DVT.

Statistical Analysis

All collected data were analyzed using SPSS version 15.0 (IBM Inc., Armonk, NY, USA). Descriptive data are presented as n

(%) values for categorical data and mean ± standard deviation and median for continuous variables. For comparisons of modified Caprini risk scores according to patients' clinical and reproductive characteristics, Fisher's exact test, Pearson's chi-square test, and the Mann-Whitney U test were used. A *p* value of <0.05 was considered statistically significant.

Table 1. Modified Caprini risk model

1-Point risk factors
Between 41-50 years old
Edema of the lower extremities
Varicose veins
Obesity (BMI >25)
Laparoscopic surgery (<45 minutes)
Minor surgical procedure planned
History of acute myocardial infarction
Inflammatory bowel disease
Abnormal pulmonary function
History of serious acute respiratory disease (including pneumonia) within 1 month
Oral contraceptive/hormone replacement therapy
Pregnancy/postpartum period
History of unexplained IUFD/recurrent miscarriage (>3)/premature birth/preeclampsia/IUGR
2-Points risk factors
Between 61-74 years old
Arthroscopic surgery
Malignancy (history or presence of cancer)
Elective major surgery
Presence of extremity cast (<1 month)
Laparoscopic surgery (>45 minutes)
Central venous catheter
Immobilized patient (more than 72 hours)
3-Points risk factors
Above 75 years old
History of DVT or pulmonary embolism
Factor V Leiden mutation
History of high homocysteine level
Prothrombin 20210A mutation
Lupus anticoagulant positivity
Heparin-dependent thrombocytopenia
Anticardiolipin antibody positivity
5-Points risk factors
Stroke within 1 month
Multiple trauma within 1 month
Hip, pelvic, or leg fracture within 1 month
Acute spinal cord injury (paralysis) within 1 month
Lower extremity arthroplasty
Low-risk group (0-1 score), moderate-risk group (2 score), high-risk group (3-4 score), very high-risk group (5 score and above) BMI: Body mass index, DVT: Deep vein thrombosis, IUFD: Intrauterine fetal death, IUGR: Intrauterine growth restriction

RESULTS

A total of 172 patients who underwent surgery for benign gynecological indications were included in the study. Of these, 96 (55.8%) received thromboprophylaxis in the postoperative period, while the remaining 76 (44.2%) did not. The distribution of patients' sociodemographic, physical, and obstetric characteristics is presented in Table 2. The mean age of the patients was 45.5±9.7 years. Among the participants, n=57 (33.1%) had a normal BMI, n=61 (35,7%) were overweight, and n=51 (29.7%) were obese. Nearly all (n=161, 93.6%) of the women had at least one previous pregnancy, while n=155 (90.1%) had given birth at least once. In addition, n=76 (44.2%) reported having experienced at least one miscarriage.

The distribution of surgical procedures is presented in Table 3. Total abdominal hysterectomy with bilateral salpingo-oophorectomy or salpingectomy was the most frequently performed operation (45.4%), followed by total laparoscopic hysterectomy with bilateral salpingo-oophorectomy (12.2%), and vaginal hysterectomy with colporrhaphy anterior and posterior (VAH + CAP) accounted for 5.2% of all procedures.

Table 4 summarizes the distribution of several clinical characteristics and the modified Caprini risk score classifications for the patients. Among the patients, n=70 (40.7%) received a single dose of anti-Xa 4000 IU/ 0.4 mL of LMWH, while 15.1% (n=26) received a single dose of anti-Xa 6000 IU/ 0.6 mL. Only one patient was found to be using hormone replacement therapy (HRT), and two patients were using oral contraceptives. The patient receiving HRT also had a history of breast carcinoma. Only one patient had a prior history of DVT. Of all participants, n=27 (15.7%) were classified in the low-to-moderate risk category, whereas n=145 (84.3%) were classified in the high-to-very-high-risk category. The mean hospitalization duration was 2±1 days, with the shortest stay being less than 1 day and the longest lasting 9 days. The mean duration of LMWH use among those who received anticoagulant therapy was 7±4 days.

Table 2. Distribution of sociodemographic, physical, and obstetric characteristics of patients

Characteristics	Mean ± SD	Median
Age	45.5±9.7	45
Weight (kg)	72.0±13.6	71
Height (cm)	161.8±6.5	162
BMI	27.5±5.0	26.9
Gravity	3±2	3
Parity	2±1	2
Number of live births	2±1	2
BMI: Body mass index, kg: Kilograms, cm: Centimeters		

Table 5 shows the postoperative thromboprophylaxis administered to patients in the low-moderate and high-very high-risk groups In total, 96 patients (55.8%) received thromboprophylaxis, with 89 (51.7%) in the high-to-very high-risk group and 7 (4%) in the low-to-moderate risk group. The remaining 76 (44.2%) did not receive medical or mechanical thromboprophylaxis, including 56 (32.5%) in the high-to-very high-risk group and 20 (11.6%) in the low-to-moderate risk group.

In the patients classified within the high-to-very-high group (n=145), n=89 (61.3%) received thromboprophylaxis, while the remaining 56 patients did not. Of those who received prophylaxis, n=63 (70.7%) were administered 0.4 mL LMWH, and n=26 (29.3%) received 0.6 mL LMWH. Among the 63 patients who received 0.4 mL LMWH, 23 received prophylaxis for fewer than seven days and 40 for more than seven days. Similalrly, in the group receiving 0.6 mL LMWH, eight patients were treated for fewer than seven days and 18 for more than seven days. Only one case of symptomatic DVT was detected, occurring in a patient who did not receive prophylaxis. However, due to the extremely low number of events, no meaningful statistical comparison regarding the effectiveness of prophylaxis could be performed (Table 6).

Table 3. Distribution of surgical procedures performed in the study population

Surgical procedure	n	%
TAH + BSO or TAH + BS	78	45.4
TLH + BSO	21	12.2
VAH + CAP	9	5.2
Myomectomy	7	4.1
Ovarian cystectomy	7	4.1
Unilateral salpingo-oophorectomy	4	2.4
Laparoscopic salpingectomy	2	1.2
Abscess drainage + bilateral salpingectomy + adhesiolysis	2	1.2
Other benign gynecological procedures*	42	24.3
Total	172	100

*Other benign gynecological procedures include less frequently performed open and minimally invasive surgeries, such as combined open pelvic floor procedures, isolated adnexal surgeries, and adhesiolysis TAH + BSO: Total abdominal hysterectomy + bilateral salpingo-oophorectomy, TAH + BS: Total abdominal hysterectomy + bilateral salpingectomy, TLH + BSO: Total laparoscopic hysterectomy + bilateral salpingo-oophorectomy, VAH + CAP: Vaginal hysterectomy + colporrhaphy anterior and posterior

Table 4. Distribution of clinical variables and modified Caprini risk score groups

Variable	n	%
LMWH administration: no	76	44.2
LMWH administration: yes	96	55.8
HRT use: no	170	98.8
HRT use: yes	2	1.2
OCP use: no	169	98.3
OCP use: yes	2	1.2
History of DVT: no	171	99.4
History of DVT: yes	1	0.6
Modified Caprini risk score: low	8	4.7
Modified Caprini risk score: moderate	19	11.0
Modified Caprini risk score: high	128	74.4
Modified Caprini risk score: very high	17	9.9

DVT: Deep vein thrombosis, LMWH: Low-molecular-weight heparin, HRT: Hormone replacement therapy, OCP: Oral contraceptive

DISCUSSION

DVT remains an important global health problem, including in Turkey, due to its association with prolonged increased patient morbidity/mortality, extended hospitalization, complications, and increased healthcare costs. Approximately half of all thromboembolic events are considered preventable through appropriate medical and surgical thromboprophylaxis. In the absence of prophylaxis, the incidence of DVT ranges from 6.2-29.1% in patients undergoing major gynecological surgery for benign conditions and from 19.6-37.9% in those undergoing major surgery for malignancy.[8,18] Despite these findings, the present study found that postoperative symptomatic DVT was observed in only 1 (0.58%) patient. This was despite 84.3% of the participants being classified as high- or very high-risk by the Caprini scoring system. However, given the very low incidence rate and the resulting risk of false negative errors, this inconsistency also suggests that the score may have limited predictive value in populations undergoing benign gynecological surgery with baseline risk.

The mean age of patients included in the study was 45.5±9.7 years, and 46±6.1 years in the high-very high-risk group. Zhang et al.,[17] aimed to identify risk factors for DVT in women undergoing gynecological surgery and found that patients who were elderly, had malignant tumors, had cardiovascular comorbidities, or received high doses of hemostatic drugs after surgery were at particularly high-risk for pulmonary embolism. Although numerous studies have consistently demonstrated that increasing age is a significant independent risk factor for postoperative DVT, including after gynecological surgical procedures,[21,22] this was not observed in our cohort. This may be explained by the relatively young age of our patient population, given that the risk of DVT increases progressively with advancing age, particularly after 60-70 years.[23,24]

Tan et al.[25] defined obesity as an independent risk factor for DVT beyond genetic predisposition to DVT in their studies. They also showed that this interaction was independent of hospitalization, the postoperative period, and immobilization.[25] In their studies, El-Menyar et al.[26] stated that obesity was not only a risk factor for DVT, but also that BMI ≥30 kg/m^2 was a predictor of survival. In the present study, 35.7% of patients were overweight, and 29.7% were obese. The average BMI in the high-very high-risk group was 35 kg/m^2. Despite the earlier evidence, no significant differences in BMI or postoperative DVT rates were observed between patients who received and did not receive prophylaxis. This inconsistency may be due

Table 5. Postoperative thromboprophylaxis administered to patients in the low-moderate and high-very high groups based on the modified Caprini risk scoring system

Variables	Modified Caprini risk score			
	Low to moderate		High to very high	
	n	%	n	%
No LMWH administration	20	11.6	56	32.5
LMWH 4000 anti-Xa IU/ 0.4 mL administration	7	4	63	36.6
LMWH 6000 anti-Xa IU/ 0.6 mL administration	-	-	26	15.1

LMWH: Low-molecular-weight heparin

Table 6. Comparison of low molecular weight heparin doses, duration, and occurrence of deep vein thrombosis in the high and very high-risk group

		n	%	*p*
Patients receiving thromboprophylaxis	LMWH 4000 anti-Xa IU/ 0.4 mL (those who used less than 7 days)	23	25.8	>0.05
	LMWH 4000 anti-Xa IU/ 0.4 mL (those who used more than 10 days)	40	44.9	
	LMWH 6000 anti-Xa IU/ 0.6 mL (those who used less than 7 days)	8	8.9	
	LMWH 6000 anti-Xa IU/ 0.6 mL (those who used less than 7 days)	18	20.2	
Patients not receiving thromboprophylaxis		56	38.7	

LMWH: Low-molecular-weight heparin

not only to the relatively young age of our study population and early postoperative mobilization, but also to the limited sample size, which may have reduced the statistical power to detect an association between obesity and DVT.

Most patients in our study were fully independent in daily activities, and the mean length of hospital stay was 2±1 days. Although immobility is a well-established risk factor for DVT,[27,28] early mobilization, typically within 6-8 hours after surgery, may have contributed to the low incidence observed in our study. Indeed, only one patient developed DVT, and this patient had no history of oral contraceptive use, HRT, thrombophilia, or familial thrombosis.

In the present study, the overall incidence of DVT following benign gynecological surgery was very low, with only one postoperative symptomatic DVT case detected in 172 patients. This finding is particularly noteworthy given that 84.3% of the study population was classified as high to very high-risk according to the modified Caprini risk scoring system. Despite this risk profile, prophylaxis practices showed considerable variability, and adherence to the thromboprophylaxis algorithms recommended in international guidelines appeared inconsistent.[29,30] Although thromboprophylaxis was administered to 61.3% of high- to very high-risk patients, more than one-third of this cohort did not receive prophylactic treatment. Furthermore, the duration of LMWH prophylaxis was generally shorter than recommended,[29] particularly in high-risk patients. Despite evidence that prolonged prophylaxis may be beneficial in patients undergoing pelvic surgery,[31] approximately one-third of patients received anticoagulant therapy for less than seven days. Furthermore, the mechanical prophylaxis recommended for moderate-risk groups was not used in any patients,[20] indicating that VTE prevention strategies were not adequately utilized. It is believed that the absence of thromboprophylaxis and the variability in dosage were influenced by several factors, including the surgeon's personal preference, perceived bleeding risk, early commencement of postoperative mobilization, a relatively short hospital stay, and the absence of additional thrombotic risk factors. Despite observed variations in prophylactic practices, the postoperative symptomatic DVT rate in this cohort was remarkably low. This result may be due to the presence of additional protective factors, including the relatively young age of the participants, the absence of central venous catheters, and the absence of significant comorbidities. These factors may have reduced the predicted risk. Furthermore, the failure to perform routine doppler ultrasound evaluations on all patients and the inability to detect asymptomatic DVT cases may also contribute to this. The appropriate use of thromboprophylaxis in benign gynecological surgery remains a matter of ongoing debate, and this study adds to a growing body of evidence questioning the routine use of prophylaxis in this setting, particularly for patients without additional VTE risk factors.[32,33] Furthermore, unnecessary use of LMWH may increase bleeding risk, patient discomfort, and healthcare costs without providing a clear clinical benefit.[34,35] Thus, this study suggests that more refined,

procedure- and population-specific risk stratification tools may be required to better identify patients who truly benefit from pharmacologic prophylaxis.

Study Limitations

Both the single-center and retrospective design, and the small patient numbers are the main limitations of the study. Other limitations include the heterogeneity of patient operations, the presence of other infectious conditions such as abscesses, and the inability to compare minimally invasive operations, such as VAH + CAP, with major operations. Moreover, the surgeon's decision to administer thromboprophylaxis may have introduced differences in demographic characteristics between the thromboprophylaxis and non-thromboprophylaxis groups, potentially leading to selection bias. Another important limitation is that, given the extremely low incidence of observed DVT, the study lacks sufficient power to detect any clinically meaningful differences between the prophylaxis groups or to test for non-inferiority. Furthermore, asymptomatic DVT cases were not investigated by routine Doppler examination. Finally, inconsistencies in the postoperative thromboprophylaxis regimens contribute to these limitations.

CONCLUSION

In conclusion, our results highlight a potential overestimation of thrombotic risk when the Caprini risk scoring system is applied without consideration of procedure- and patient-specific factors. We believe that there is a need for gynecology-specific risk assessment tools that more accurately reflect the clinical profile of this population. Further prospective, multicenter studies with larger sample sizes are warranted to clarify optimal thromboprophylaxis strategies and to refine risk stratification in benign gynecologic surgical practice.

Ethics

Ethics Committee Approval: The reviewed and approved this study University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital Local Ethics Committee (approval no: 21, date: 26.01.2017).

Informed Consent: Due to the retrospective nature of the study, it is exempt from the requirement for informed consent.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.C.D., A.D., Concept: A.C.D., A.D., Design: A.C.D., Data Collection or Processing: A.C.D., Analysis or Interpretation: A.C.D., Literature Search: A.C.D., Writing: A.C.D., A.D.,

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