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The adapted Caprini score as a proxy for postoperative venous thromboembolism prophylaxis: a tertiary hospital experience

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Background: Postoperative patients' risk for developing venous thromboembolism (VTE) can be predicted using the adapted Caprini risk assessment model which informs administration of postoperative VTE prophylaxis. The study aimed to assess the appropriateness of postoperative VTE prophylaxis of patients according to the adapted Caprini scores and investigate whether a patient's HIV status influenced postoperative VTE prophylaxis administration.
Methods: This cohort study included patients who had elective or urgent surgery at a tertiary hospital, Bloemfontein. Data from patient files were captured on datasheets that comprised the adapted Caprini risk assessment model. The type of prophylaxis received was noted. The appropriateness of the prophylaxis prescribed was compared with the patient's score.
Results: Details of 147 patients were included. Three of the 16 patients who did not qualify for prophylaxis, were on VTE prophylaxis on day-one post-surgery. Only 24 (18.3%) of the 131 patients who qualified for prophylaxis were on prophylaxis one day post-surgery. Of the prophylaxis prescribed, 88.5% was enoxaparin, and 11.5% "other", mainly aspirin. Twenty-three (17.6%) patients who qualified for prophylaxis were discharged on prophylaxis. Of the 147 patients, 24 patients were HIV positive, and eight of these patients received postoperative VTE prophylaxis.
Conclusion: The majority of postoperative patients at the various surgical departments of the hospital did not receive appropriate postoperative VTE prophylaxis compared to the adapted Caprini scores obtained from their medical information. A patient's HIV status alone did not influence the decision of administering postoperative VTE prophylaxis.
Keywords: deep vein thrombosis, postoperative prophylaxis, adapted Caprini risk assessment

Background

Venous thromboembolism (VTE) includes deep venous thrombosis (DVT) and pulmonary embolism (PE).[1] DVT is a blood clot that occurs mostly in the deep veins of the lower limb, but can also occur in the vena cava, deep veins of the upper limbs and visceral veins. PE occurs when such a clot travels to the lungs. The occurrence of VTE is equal between the sexes but increases as people age.[1] There is an increase in mortality shortly after development of VTE as well as in the long-term.[2]

The Caprini risk assessment model (RAM) or scoring system was originally developed for surgical patients to determine the VTE risk by adding individual risk factors and placing patients into four categories: "low risk" (0–1 points), "moderate risk" (2 points), "high risk" (3–4 points), and "highest risk" (5 or more points).[3] Table I outlines some of the most important risk factors that the Caprini scoring system takes into account:[4]

The Caprini score of patients can be determined in various ways, including the evaluation of medical records or face-to-face interaction with the patient. Determining Caprini scores solely from medical records may provide inaccurate information regarding VTE in comparison to face-to-face interactions with the patients, as additional information such as family history and presence of varicose veins could be absent in medical records and only be clarified during interviews.[5] Despite the score not being able to include all risk factors and assessor variation can occur, it is a practical tool which can enhance clinical care to reduce the development of VTE and subsequent mortality.[6]

The Caprini RAM was validated in a large retrospective study that included general, vascular and urology surgical patients.[7] The study showed that in patients with a Caprini score of 0–1, only frequent ambulation without prophylactic treatment is necessary. Patients with a score of 2 should be treated with mechanical prophylaxis, such as intermittent pneumatic compression. Patients with a score of 3–4 should be treated with mechanical or pharmacological prophylaxis while high-risk patients should receive both mechanical and pharmacological prophylaxis.[7]

Sterbling et al.[8] concluded that it is beneficial to determine a patient's postoperative Caprini score as it will contribute to decreasing the occurrence of VTE. A study of 48 hospitals in Michigan, US, showed a 15% decrease in the presence of VTE with pharmacological prophylaxis after an analysis of the patients' Caprini score.[3] The study concluded that there is a linear association between the Caprini score and the risk of a patient developing VTE. The study further suggested that reserving prophylaxis for patients with a Caprini score of ≥ 5 will be the most acceptable strategy to balance the benefits of

Table I: Important risk factors taken into account by the Caprini scoring system[4]

Factors related to disease	Factors related to surgery	Factors related to medical history	Factors not related to disease or surgery
Varicose veins	Minor surgeries (45 min)	History of major surgery	Age
Swollen legs	Bed rest after surgery	Inflammatory bowel disease	Obesity (body mass index > 25 kg/m^2)
Acute myocardial infarction	Confined to bed > 3 days	Deep vein thrombosis	
Congestive heart failure	Arthroscopic surgery	Thrombophilia	
Sepsis	Laparoscopic surgery	Stroke within a month ago	
Lung diseases	Central venous access		
Malignant tumours	Elective lower extremity arthroplasty		
Immobilising plaster cast			
Acute spinal cord injury			
Multiple trauma			
Hip fracture			

preventing VTE while at the same time minimising the risks associated with anticoagulation medication (e.g. increased bleeding risk, cost, etc.). Although a clear correlation exists between increasing Caprini score and increasing VTE risk, a systematic review has found variation in the prevalence of VTE post-surgery in the various Caprini risk groups.[9]

Compression stockings and intermittent pneumatic stockings are the most frequently used mechanical methods for VTE prophylaxis of the lower limb.[10] Compression stockings put pressure on and compress veins, which causes a decrease in the diameter and improves the velocity of blood flow. Intermittent pneumatic stockings support the effect of compression done by these stockings by inflating and deflating cuffs around the limbs. The occurrence of DVT is therefore reduced by increasing the velocity of blood flow, which leads to less clotting of blood.[10] Sadaghianloo and Dardik[11] evaluated the effectiveness of intermittent pneumatic stockings to prevent DVT in postoperative patients. Randomised controlled trials showed that intermittent pneumatic devices significantly reduced the risk of VTE, but this should be used with other modalities in high-risk patients.

South Africa is burdened by a high prevalence of HIV-positive patients. Due to the HIV replication itself, an active opportunistic infection may be present while the levels of CD4+ T-cells are low.[12] These factors may cause continuous systemic inflammation because of an upregulation of procoagulant factors and a decrease in the regulation of fibrinolysis and anticoagulation factors, which contribute to the formation of DVT. HIV thus increases the risk of DVT.[13,14] A retrospective study[12] conducted in Spain found a significant upward tendency in the incidence of DVT-hospitalisation in HIV-infected patients.

During a prospective observational study[15] conducted in South India during 2016, an adapted version of the Caprini scoring system was used to assess the risk for VTE in postoperative patients in a tertiary care hospital. The adapted version of the Caprini score excluded the haematological laboratory parameters of the original version (Factor V Leiden, anti-cardiolipin antibodies, serum homocysteine, prothrombin 20210A and lupus anticoagulant) due to cost constraints or unavailability of the tests. This adapted version of the Caprini score was validated by the same study as an adequate scoring system to calculate the risk for the development of VTE in postoperative patients.[15]

The Caprini RAM is an effective model for calculating the risk of postoperative patients to develop VTE and therefore deciding the appropriate prophylactic treatment for each unique patient. As doctors are not obliged to calculate a patient's Caprini score after surgery, it served as motivation to compare the appropriateness of VTE prophylaxis for postoperative patients with their individual Caprini scores. In addition, in view of the high prevalence of HIV in South Africa, there is a theoretical increased risk for postoperative VTE in our patient population. Our secondary objective was to evaluate the influence of a patient's HIV status on the doctor's decision to prescribe VTE prophylaxis.

Aim

The primary aim of this study was to assess the appropriateness of the postoperative VTE prophylaxis of patients according to their adapted Caprini scores at a tertiary hospital in Bloemfontein, South Africa. The secondary aim was to investigate whether a patient's HIV status influenced the decision to administer postoperative VTE prophylaxis, regardless of their Caprini scores.

Methods

Study design and sample population

The target population of this cohort study included patients 18 years and older who had elective or urgent surgery at Universitas Academic Hospital from June 2019 to October 2019. Six surgical departments were included: urology, neurosurgery, orthopaedic surgery, plastic surgery, general surgery and otorhinolaryngology. Consecutive sampling was used.

Exclusion criteria included missing files, incomplete patient files, patients who died during hospitalisation, and patients who did not consent to participate in the study. The information of 147 out of 149 patients was included. Two patients were excluded from the study as they were not discharged and were in hospital for more than 3 months.

Measurement

The adapted Caprini scoring system[15] was used to determine a patient's risk of developing VTE postoperatively. The adapted Caprini scoring system evaluates demographic factors, such as gender and age, and medical conditions and

risk factors contributing to VTE. The calculated score places a patient in one of the following risk categories: very low (0–1), low (2), moderate (3–4) or high (≥ 5).

The data form included the standardised, validated, adapted Caprini scoring system.[15] Each risk factor in the adapted Caprini scoring system has a differential score, which indicates the desired level and type of prophylactic treatment a patient should receive. Thereafter the differential score was compared to the actual level of treatment the patient was receiving to evaluate whether patients were receiving proper and appropriate treatment, namely prophylaxis on day one after surgery and at discharge. Data were also collected on whether the patient received intermittent pneumatic stockings, the patient's HIV status and antiretroviral treatment.

The researchers completed the data forms using information available to doctors after elective or urgent surgery and obtained primarily from the patients' files as well as from Meditech notes, radiology reports, clinic data and the NHLS database. Any unavailable information was captured on the data form as a 'no/no risk' since this information would not have been available to the doctors to assess whether they needed to prescribe VTE prophylaxis after surgery.

Patients were asked to sign a consent form after they read and understood the information document, which was available in English, Afrikaans, Sesotho and isiXhosa. A brief voice recording of the precise wording of a part of the information document that explained the study, in the languages mentioned, was played to the patients on a cell phone, thus avoiding confusion and ensuring clarity and consistency. If the researchers noted that a patient was still not able to fully comprehend the purpose of the study, even after playing the voice recording, the patient was excluded.

Pilot study

A pilot study included the first 10 patients of June 2019 and evaluated the appropriateness and effectiveness of the data form and methodology. Following conclusion of the pilot study, no adjustments were needed, and the 10 patients were included in the study.

Analysis

The information on the data forms was entered into a Microsoft Excel sheet. The data were analysed by the Department of Biostatistics, Faculty of Health Sciences of the University of the Free State using SAS Version 9.4. Numerical variables were summarised by medians, minimum, maximum. Categorical variables were summarised by frequencies and percentages. Patients qualified for prophylactic treatment with an adapted Caprini score of ≥ 3.

Ethical aspects

Participation in the study was voluntary. Patients were only included once they had given written consent. All patient information gathered was kept confidential and anonymised. The researchers captured the data from patient files at the patients' bedside in the relevant wards. The data forms contained a space for the unique number that was given to each patient through a consecutive coding system (e.g., Patient Number 1).

Results

Of the 147 patients, 71 (48.3%) were male and 76 (51.7%) were female. Patient distribution according to age groups was ≤ 40 years (n = 48; 32.7%), 41–60 years (n = 53; 36.1%), 61–74 years (n = 36; 24.5%) and ≥ 75 years (n = 10; 6.8%).

Three-quarters of the patients were from the departments of orthopaedic surgery (n = 38; 25.9%), urology (n = 37; 25.2%) and general surgery (n = 36; 24.5%). The remaining patients were from the departments of plastic surgery (n = 14; 9.5%), neurosurgery (n = 11; 7.5%) and otorhinolaryngology (n = 11; 7.5%). As per the risk stratification for the adapted Caprini score, the majority (n = 105; 71.4%) of the patients underwent major surgery, 25 (17.0%) had minor surgery and 17 (11.6%) had elective major lower extremity arthroplasty.

Table II shows the distribution of patients according to their adapted Caprini score and allocation to risk group. The median adapted Caprini score was 5 (range 1–17).

Table II: Distribution of patients according to their adapted Caprini score (n = 147)

Adapted Caprini score	Risk group	n (%)
1	Very low risk	3 (2.0)
2	Low risk	13 (8.8)
3	Moderate risk	26 (17.7)
4		20 (13.6)
5	High risk	25 (17.0)
6		20 (13.6)
7		13 (8.8)
8		3 (2.0)
9		4 (2.7)
10		6 (4.1)
11		3 (2.0)
12		3 (2.0)
13		4 (2.7)
14		3 (2.0)
17		1 (0.7)

According to the adapted Caprini scores in Table II, three (2.0%) patients were in the very low-risk group, 13 (8.8%) in the low-risk group, 46 (31.3%) in the moderate risk group and 85 (57.8%) in the high-risk group. Table III illustrates the factors that were present in more than 5% of the population.

Only 16 (10.9%) of the 147 patients did not require prophylactic treatment, while 131 (89.1%) did. Only 24 (18.3%) of the 131 patients who qualified for prophylaxis were on prophylaxis one day post-surgery. Three of the 16 patients who did not qualify for prophylaxis were on prophylaxis one day post-surgery. Twenty-three (17.6%) of the patients who qualified for prophylaxis were also discharged on prophylaxis (treatment for 10 days).

Table IV shows prophylaxis per risk group. The highest adapted Caprini score obtained without receiving prophylaxis was 14.

The prophylaxis one day post-surgery was mainly enoxaparin (23, 88.5%). Three cases (11.5%) received aspirin. Patients who were discharged on prophylaxis received enoxaparin (n = 7) and other forms of prophylaxis that mainly included aspirin (n = 16).

Most (n = 140; 95.2%) did not receive any form of intermittent pneumatic stockings, two (1.4%) received

Table III: Main factors that contributed to the patients' adapted Caprini scores (n = 147)

Factor	Adapted Caprini score	n (%)
Age		
≤ 40 years of age	0	48 (32.7)
41–60 years of age	+1	53 (36.1)
61–74 years of age	+2	36 (24.5)
≥ 75 years of age	+3	10 (6.8)
Type of surgery		
Minor surgery	+1	25 (17.0)
Major surgery > 45 min	+2	105 (71.4)
Elective major lower extremity arthroplasty	+5	17 (11.6)
Risks associated with DVT		
Presence of an immobilising plaster cast	+2	11 (7.5)
Previous/past malignancy	+2	33 (22.5)
Hip, pelvis or leg fracture	+5	9 (6.1)
Venous disease or clotting disorder		
Swollen legs	+1	11 (7.5)
Mobility		
Mobile, normal, out of bed	0	86 (58.5)
Medical patient currently on bed rest	+1	47 (32.0)
Patient confined to bed > 72 hours	+2	14 (9.5)
Other present and past history		
Patient BMI > 25 kg/m^2	+1	61 (41.5)

BMI – Body mass index; DVT – Deep vein thrombosis

Table IV: Prophylaxis per risk group, one day after surgery and at discharge

Risk group	Prophylaxis received	
	One day post-surgery	At discharge
	n (%)	n (%)
Very low (n = 3)	0 (0)	0 (0)
Low (n = 13)	3 (23.1)	0 (0)
Moderate (n = 46)	2 (4.4)	3 (6.5)
High (n = 85)	22 (25.9)	20 (23.5)

intermittent pneumatic stockings intraoperatively, and five (3.4%) postoperatively.

Of the 147 patients, 24 (16.3%) patients were HIV positive, of which 21 (87.5%) were receiving antiretroviral treatment. According to their adapted Caprini scores, 20 (80.0%) of the HIV-positive patients qualified for postoperative VTE prophylaxis, of which eight (40.0%) received treatment. Seven of these eight patients had an adapted Caprini score > 5 and were thus in the high-risk group. Of the 111 HIV-negative patients who qualified for postoperative VTE prophylaxis, 16 (14.4%) received treatment, of whom 15 were in the high-risk group.

Discussion

Of 147 patients, 57.8% had a high (≥ 5) adapted Caprini score, placing them at a high risk of developing VTE. Possible reasons for the high adapted Caprini scores could be that 67.3% of the patients were older than 40 years and 83.0% either had major surgery or elective major lower extremity arthroplasty. Almost half of the patients had different levels of immobility, and 41.5% of patients had a BMI greater than 25 kg/m^2. Other factors that played a role in the high adapted Caprini scores were patients who had an immobilising plaster cast, patients who had a hip, pelvis or leg fracture, previous or present malignancies, and patients who had swollen veins or underwent minor surgery.

Almost a third (31.3%) of the patients had a moderate risk (with a score of 3–4) of developing VTE. Laryea and Champagne[7] advised that moderate risk patients should be treated with mechanical or pharmacological prophylaxis.

According to their adapted Caprini scores (≥ 3), 131 (89.1%) patients qualified for prophylaxis. Three patients who did not qualify for treatment did, however, receive VTE prophylaxis. Prophylactic resources are therefore not wasted nor used in a careless and irresponsible manner at Universitas Academic Hospital. However, the number of patients who did qualify for prophylaxis but did not receive any form of prophylaxis is worrisome. Only 24 (18.3%) patients who qualified for prophylaxis correctly received prophylaxis one day after surgery, and therefore, 81.7% of the patients who met the criteria for receiving prophylaxis did not receive treatment. A study of 179 patients at Frere Hospital in the Eastern Cape considered a Caprini score of 2 and above as at risk. Taking into account the patients' contraindications to chemoprophylaxis, 26% of at-risk patients received the correct thromboprophylactic treatment prescription.[16]

During a 2017 study,[17] interviews were conducted with senior-level physicians from 13 countries on the decision-making for VTE prophylaxis. During the interview with the participating South African physicians, it came to light that there were vast differences between prescribing prophylactic treatment to patients in the public versus private sectors. Another study[18] concluded that the lack of prescribing postoperative prophylaxis could be due to logistical constraints regarding patient compliance, lack of awareness from doctors, or lack of local adaptation of a country's national guidelines regarding postoperative prophylaxis.

The preferred form of prophylaxis at Universitas Academic Hospital is enoxaparin; 23 of the 26 patients received enoxaparin one day after surgery, while three patients received other pharmacological prophylaxis, mainly aspirin. In comparison, seven patients were discharged on enoxaparin, and 16 were discharged on aspirin. The patients who were discharged on aspirin were not taking aspirin chronically, and the conclusion could be made that they were discharged on aspirin as a form of VTE prevention. At the time of our study, aspirin was often used for VTE prophylaxis in orthopaedic patients due to no access to newer generation anticoagulation, such as rivaroxaban (Xarelto), in the state sector. There is literature to support this in low-risk patients,[19] but it should not typically be used as sole agent; for example, enoxaparin should be prescribed in hospital for 5 days, then the patient can be discharged on aspirin.[19]

Alhassan et al.[20] found that the characteristics of patients who develop VTE after being discharged differed from the characteristics of patients who develop VTE during hospitalisation. They concluded that it would be beneficial to identify patients at high risk of developing VTE post-discharge and prescribe a form of prophylaxis. Extended prophylaxis post-discharge should be given to patients after abdominopelvic surgery for malignancy with other high-risk features including obesity, decreased mobility, history

of VTE or additional risk factors with a high Caprini score > 9.[6]

Agaba et al.[21] compared enoxaparin and aspirin as forms of postoperative prophylaxis and found that the lowest risk for developing a pulmonary embolism postoperatively occurred through the administration of enoxaparin. The same study also concluded that aspirin is an inexpensive, easily administered form of postoperative VTE prophylaxis with relatively low thromboembolic and bleeding risk. Another study[22] conducted on patients undergoing arthroscopic rotator cuff repair, found that aspirin did not lead to a clinically significant reduction in either DVT or rates of pulmonary embolism and that in this low-risk group, mechanical prophylaxis and early mobilisation are sufficient methods of venous thromboembolism prophylaxis. It is advised that enoxaparin should be deemed the pharmacological treatment of choice for postoperative VTE prophylaxis.[23] For certain orthopaedic procedures, aspirin is considered appropriate.[24]

It appears that the HIV status of a patient alone does not influence the decision for administering postoperative VTE prophylaxis at Universitas Academic Hospital, but that HIV-positive patients with high scores were more likely to receive prophylaxis than HIV-negative patients with high scores.

Study limitations

The study did not investigate why patients who qualified for prophylaxis did not receive treatment. Data were not collected on whether patients were already taking thromboprophylaxis before the surgery or whether a medical condition prevented them from taking aspirin, even though they qualified for treatment as per their adapted Caprini score. Exclusion of patients due to death or not being discharged could have introduced bias. The prevalence of VTE in this cohort is not known. Patients were not followed up after discharge to determine compliance or VTE incidence. Re-evaluation is problematic since patients are from the Free State as well as Northern Cape provinces, and do not always attend follow-up visits.

Conclusion and recommendations

The majority of adapted Caprini scores calculated from 147 postoperative patients at various surgical departments at Universitas Academic Hospital were high, and therefore, most of these patients qualified for postoperative VTE prophylaxis. The number of patients who received postoperative VTE prophylaxis a day after surgery and at discharge was low. HIV status alone seemingly does not influence the decision to administer postoperative VTE prophylaxis but in conjunction with a high Caprini score led to more frequent prophylaxis prescription.

Health care practitioners should be educated regarding the existing guidelines for preventing VTE in surgical patients. These patients should also be educated on the risks and complications of postoperative VTE, which would ensure better patient compliance when receiving postoperative VTE prophylaxis. Steps to ensure that VTE risk assessment becomes part of clinical practice include mandatory determination of Caprini scores on admission or mandatory prophylaxis given to all patients in theatre, except where contra-indicated. Further research could include comparing the implementation of postoperative VTE prophylaxis in public and private health sectors of South Africa, as this may indicate the impact of financial constraints on postoperative VTE prophylaxis. Other research possibilities include a comparison between the prescription of VTE prophylaxis between the various surgical departments at Universitas Academic Hospital. In addition, patients should be followed up for 6 months or a year after discharge to assess whether they developed VTE. A questionnaire survey of prescribing doctors regarding their knowledge of existing guidelines and their attitudes towards prescribing prophylaxis would give insight into reasons for inadequate prescription.

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Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

The protocol was approved by the Health Sciences Research Ethics Committee, Faculty of Health Sciences of the University of the Free State [UFS-HSD2019/0128/2506]. Permission to conduct the study was obtained from the Free State Department of Health and Universitas Academic Hospital.

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