ORIGINAL RESEARCH

Comparative evaluation of venous thromboembolic risk in urologic inpatients using different risk assessment models

Konstantinos Douroumis[1], Evangelos Fragkiadis[1], Napoleon Moulavasilis[1], Panagiota Stratigopoulou[2], Ioannis Adamakis[1], Ioannis Anastasiou[1], Dionysios Mitropoulos[1]

[1]First Department of Urology, National and Kapodistrian University of Athens, Athens, Greece; [2]Anesthesiology Department, Laikon General Hospital of Athens, Athens, Greece

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ABSTRACT

INTRODUCTIONS: The process for determining thromboprophylaxis decisions in urologic surgery entails assessing the risk of venous thromboembolism (VTE) in comparison to the risk of bleeding. Risk assessment models (RAMs) have been created to systematically calculate an individual's risk of VTE. In our study, we evaluated the risk of VTE in urologic inpatients using two RAMs specifically designed for urology by the European Association of Urology (EAU) and the American Urological Association (AUA), the Caprini score, and the CHA2DS2-VASc score.

METHODS: The study group consisted of 136 inpatients within the urology department. Data from medical records included information on various factors, such as age, gender, and body mass index, as well as personal and family history of the patients. The risk of VTE was determined using the RAMs provided by EAU and AUA, the Caprini score, and the CHA2DS2-VASc score.

RESULTS: Chemical prophylaxis was advised for 48 (35.3%) patients according to the EAU model, 47 patients (34.6%) according to the AUA model, 128 (94.1%) patients based on the Caprini score, and 80 (58.8%) patients according to the CHA2DS2-VASc score. Limitations of the study include a small sample size and lack of post-surgery venous thromboembolic events recording.

CONCLUSIONS: The VTE RAMs developed by the EAU and AUA provide consistent recommendations for thromboembolism prophylaxis in urologic patients, while the Caprini model's strict adherence may lead to excessive prophylaxis recommendations. The EAU approach is user-friendly but urologists must judiciously weigh bleeding and VTE risks on an individual basis, ensuring optimal prophylaxis use.

INTRODUCTION

Urologic patients, particularly men over the age of 50, are considered at high risk for venous thromboembolic events (VTE). This risk is underscored by a prior study revealing that 30.5% of hospitalized urology patients were on antiplatelet/anticoagulation agents.[1] A recent pilot observational study found that 25% of urologic patients not receiving these agents could be considered at an increased thromboembolic risk based on European Association of Urology (EAU) criteria.[2,3]

The significance of VTE complications in urologic surgery cannot be understated, contributing to perioperative morbidity and mortality. Approximately 1–5% of urologic surgery patients develop VTE symptoms,[4-6] with pulmonary embolism being the most common cause of postoperative death.[7]

This raises concerns about the necessity of prophylactic antithrombotic treatment, especially for patients undergoing potentially hemorrhagic operations.[8-11] Decisions on thromboprophylaxis involve balancing the risk of VTE against bleeding, considering patient- and procedure-specific factors. Risk assessment models (RAMs) have been developed to calculate individual VTE risk, aiming to minimize unnecessary chemoprophylaxis; however, there is significant variation between RAMs in terms of composition and risk category assignment.

In this study, we aimed to estimate VTE risk in urologic inpatients using two urology-specific RAMs developed by the EAU[3] and the American Urological Association (AUA),[12] an older and more general model,

KEY MESSAGES

- EAU and AUA VTE RAMs provide consistent recommendations for thromboembolism prophylaxis in urologic patients.
- Caprini model may lead to excessive prophylaxis recommendations.
- EAU model is user-friendly and based on high-value evidence.
- Decision for prophylaxis should be based on individual patients.

the Caprini score,[13] and a cardiology-specific one, the CHA^{2}DS^2-VASc score,[14] primarily used in atrial fibrillation patients. The study compared the recommendations for chemical prophylaxis between these different RAMs. The findings will contribute to a better understanding of the risk-benefit balance in administering prophylactic antithrombotic treatment in urologic surgery.

METHODS

This study involved a prospective analysis of data collected over a 20-month period, spanning from March 2021 to October 2022. All urology inpatients scheduled for surgery were considered eligible for inclusion. Informed consent was obtained from the patients, and the study received approval from the scientific and ethics committee of our hospital.

The study cohort comprised 136 patients, ranging in age from 20–96 years, with a mean age of 66.4±14.4 years, and the majority (80.9%) were male. Body mass index (BMI) ranged from 19.1–43.5, with a mean of 27.4±4.1. Surgical procedures included major pelvic operations in 25 patients (18.4%), endoscopic operations of the upper urinary tract in 29 patients (21.3%), endoscopic operations of the lower urinary tract in 44 patients (32.4%), operations involving the penis, urethra, and scrotum in nine patients (6.6%), laparoscopic operations in five patients (3.7%), and open operations of the upper urinary tract in 24 patients (17.6%). Additionally, 25 patients received some form of antiplatelet or anticoagulant agent. Patient characteristics are summarized in Table 1.

Table 1. Patient characteristics

Patients, n (%)	136 (%)
Age, years	66.4±14.4 (20–96)
Gender	
Male	110 (80.9%)
Female	26 (19.1%)
BMI	27.4±4.1 (19.1–43.5)
Type of surgery	
Major pelvic	25 (18.4)
Upper urinary tract endoscopy	29 (21.3)
Lower urinary tract endoscopy	44 (32.4)
Penis, urethra, and scrotum	9 (6.6)
Laparoscopic	5 (3.7)
Open surgery of the upper urinary tract	24 (17.6)

BMI: body mass index.

Patient records provided comprehensive information on various factors, including age, gender, BMI, personal and family history of VTE, trauma (major or lower extremity), immobility, paresis, malignancy, cancer therapy (hormonal, chemotherapy, or radiotherapy), pregnancy and the postpartum period, estrogen-containing oral contraception or hormone replacement therapy, selective estrogen receptor modulators, acute medical illness, heart or respiratory failure, inflammatory bowel disease, nephrotic syndrome, myeloproliferative disorders, paroxysmal nocturnal hemoglobinuria, smoking, varicose veins, central venous catheterization, and inherited or acquired thrombophilia. The calculation of VTE risk and recommendations for prophylaxis used the EAU VTE, AUA VTE, Caprini, and CHA^{2}DS^2-VASc scores.

Data collection, extraction, and organization were carried out using Microsoft Office (Microsoft, Redmond, Washington, DC, U.S.). Statistical analyses were conducted employing the χ2-test and analysis of variance (ANOVA) test.

RESULTS

According to the EAU VTE RAM, 78 (57.4%) patients were considered low VTE risk, 50 (36.8%) patients were considered medium VTE risk, and eight (5.9%) patients were considered high VTE risk. The AUA VTE RAM categorized the patients as follows: seven (5.1%) patients had low VTE risk, 73 (53.7%) patients had moderate VTE risk, 44 (32.4%) patients had high VTE risk, and 12 (8.8%) patients had highest VTE risk. As for Caprini score, the values were ranged from 0–11,

with a mean range 6.1±1.9, and it was very low (0) in two (1.5%) patients, low (1–2) in nine patients (6.6%), moderate (3-4) in 16 patients (11.8%), and high (≥5) in 109 patients (80.1%). Finally, CHA²DS²-VASc score values ranged from 0–6, with a mean value of 1.9±1.4. Patients' categorization in VTE risk groups is summarized in Table 2.

Caprini score values had statistically significant variance ($p<0.001$) between the different EAU and AUA VTE risk groups. Specifically, low EAU VTE risk patients had a 5.5±2.1 mean Caprini score, medium-risk patients had a 6.5±1.3 mean Caprini score, and high-risk patients had a 8.5±0.7 mean Caprini score. Similar results were observed in the comparison between AUA VTE risk groups and the patients' Caprini score. Low-risk AUA VTE risk patients had a 1.7±1.6 mean Caprini score, moderate-risk patients had a 5.7±1.7 mean Caprini score, high-risk patients had a 6.9±1.4, and highest-risk patients had a 7.2±0.9 mean Caprini score.

Also, statistically significant variance ($p<0.001$) in the mean CHA²DS²-VASc score values was observed between the different EAU and AUA VTE risk groups. Mean CHA²DS²-VASc score values were 1.3±1.2, 2.8±1.1, and 3.4±1.3 in EAU low-, medium-, and high-risk patients, respectively. AUA low VTE risk patients had a 0.3±0.5 mean CHA²DS²-VASc score, moderate-risk patients had 2.0±1.4, high-risk patients had 2.1±1.3, and highest-risk patients had 2.6±1.4 mean CHA²DS²-VASc score values. Also, a statistically significant correlation between Caprini score values and CHA²DS²-VASc score values was observed ($p<0.001$).

After categorizing the patients according to EAU RAM, the recommendation for prophylaxis is based on the type of surgery.[3] Mechanical prophylaxis was recommended in 52 (38.2%) patients and chemoprophylaxis, with low-molecular-weight heparins or direct-acting oral anticoagulants, in conjunction with mechanical prophylaxis, in 48 (35.3%) patients.

Table 2. Patients' categorization in VTE risk groups according to different RAMs

	Risk assessment model		
VTE risk category	EAU	AUA	Caprini
Low	78 (57.4%)	7 (5.1%)	11 (8.1%)
Medium/moderate	50 (36.8%)	73 (53.7%)	16 (11.8%)
High/higher	8 (5.9%)	44 (32.4%)	109 (80.1%)
Highest		12 (8.8%)	

AUA: American Urological Association; EAU: European Association of Urology; RAMs: risk assessment models; VTE: venous thromboembolism.

In the AUA RAM, the type of surgery is one of the major components in the categorization of patients.[12] A combination of mechanical and chemical prophylaxis was recommended in 47 (34.6%) patients and a decision between mechanical and chemical could be made in 17 (12.5%) patients.

On the other hand, according to Caprini score a combination of mechanical and chemical prophylaxis should be administered to 128 (94.1%) patients, and a decision between mechanical and chemical should be made in 4 (2.9%) patients.[15]

Finally, 80 (58.8%) patients should receive chemoprophylaxis according to the CHA²DS²-VASc score, and 33 (24.3%) patients could receive chemoprophylaxis, but with a weak recommendation. It should be noted that the first-line chemoprophylaxis recommended for atrial fibrillation is direct-acting oral anticoagulants.[16]

DISCUSSION

Thromboprophylaxis following major urologic surgery is a subject of ongoing debate, requiring careful consideration of the balance between the risk of VTE and bleeding. Both major urologic societies have devised VTE RAMs tailored to patients and surgeries, aiming for simplicity and practicality.

The VTE RAM by the EAU is based on high-quality evidence but lacks validation.[3,17] Similarly, the AUA has its own model, which remains unvalidated.[12,18] In contrast, the Caprini score has been validated across various surgical domains,[15,19-21] and the CHA²DS²-VASc score, although traditionally used in atrial fibrillation, has robust evidence.[22]

Comparing recommendations for thromboembolism prophylaxis, both EAU and AUA models align closely, suggesting a combination of mechanical and chemical prophylaxis for approximately 35–36% of patients. Conversely, the Caprini model advocates prophylaxis for a significantly higher percentage of patients, raising concerns about its specificity in urologic surgery.

Studies supporting the Caprini score's application in major urologic surgery highlight a challenge in discriminating thromboprophylaxis needs, especially for older patients undergoing malignancy-related procedures.[23] Notably, a meta-analysis indicates that the benefit of chemoprophylaxis using the Caprini score is most evident in patients with scores ≥7.[24]

The CHA²DS²-VASc score, although not previously used in surgical cohorts, demonstrates its predictive ability for thromboembolic risk in atrial fibrillation

patients;[16,25] however, its application in urologic surgery requires further exploration.

Noteworthy variations in Caprini score values among different VTE risk groups, as well as significant differences in CHA^{2}DS^2-VASc score values, emphasize the ability of EAU and AUA VTE RAMs to effectively stratify patients' VTE risk, aligning with validated models.

While the Caprini score boasts precision with numerous factors, the EAU VTE RAM stands out for its simplicity, considering only four key factors; however, limitations of the study, including a small sample size and lack of post-surgery VTE recording, should be acknowledged.

CONCLUSIONS

The VTE RAMs developed by the EAU and AUA provide consistent recommendations for thromboembolism prophylaxis in urologic patients, while the Caprini model's strict adherence may lead to excessive prophylaxis recommendations. The EAU approach is user-friendly, but urologists must judiciously weigh bleeding and VTE risks on an individual basis, ensuring optimal prophylaxis use.

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REFERENCES

1. Anastasiou I, Mihalakis A, Mygdalis V, et al. Patterns of antiplatelet and anticoagulant agents use in urological inpatients and their perception of adverse reactions. *Surg Sci* 2012;3:200-5. https://doi.org/10.4236/ss.2012.34038
2. Frangiadis E, Papaioannou C, Moulavasilis N, et al. Anticoagulants (AC) and antiplatelets (AP) use by patients undergoing urological procedures. 39th SIU Congress, October 17-20 2019, Athens, Greece. Abstract No UP-311, Abstract book p. 207
3. EAU Guidelines. Edn. presented at the EAU Annual Congress Amsterdam 2022. ISBN 978-94-92671-16-5.
4. Brenner DW, Fogle MA, Schellhammer PF. VTE. *J Urol* 1989;142:1403-11. https://doi.org/10.1016/S0022-5347(17)39111-5
5. Kible AS, Loughlin KR. Pathogenesis and prophylaxis of postoperative thromboembolic disease in urological pelvic surgery. *J Urol* 1995;153:1763. https://doi.org/10.1016/S0022-5347(01)67302-6
6. Koch MO, Smith JA. Low molecular weight heparin and radical prostatectomy: A prospective analysis of safety and side effects. *Prostate Cancer Prostatic Dis* 1997;1:101-4. https://doi.org/10.1038/sj.pcan.4500214
7. Geerts WH, Pineo GF, Heit JA, et al. Prevention of venous thromboembolism: The Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. *Chest* 2004;126:338S-400S. https://doi.org/10.1378/chest.126.3_suppl.338S
8. Kozek-Langenecker S, Fenger-Eriksen C, Thienpont E, et al. European guidelines on perioperative venous thromboembolism prophylaxis. *Eur J Anesthesiol* 2018; 35:116-22. https://doi.org/10.1097/EJA.0000000000000705
9. Anderson DR, Morgano GP, Bennett C, et al. American Society of Hematology 2019 guidelines for management of venous thromboembolism: Prevention of venous thromboembolism in surgical hospitalized patients. *Blood Adv* 2019;3:3898-944. https://doi.org/10.1182/bloodadvances.2019000975
10. Tikkinen KAO, Craigie S, Agarwal A, et al. Procedure-specific risks of thrombosis and bleeding in urological non-cancer surgery: Systematic review and meta-analysis. *Eur Urol* 2018;73:236-41. https://doi.org/10.1016/j.eururo.2017.02.025
11. Tikkinen KAO, Craigie S, Agarwal A, et al. Procedure-specific risks of thrombosis and bleeding in urological cancer surgery: Systematic review and meta-analysis. *Eur Urol* 2018;73:242-51. https://doi.org/10.1016/j.eururo.2017.03.008
12. Forrest JB, Clemens JQ, Finamore P, et al. AUA Best Practice Statement for the prevention of deep vein thrombosis in patients undergoing urologic surgery. *J Urol* 2009;181:1170-7. https://doi.org/10.1016/j.juro.2008.12.027
13. Caprini JA, Arcelus JI, Hasty JH, et al. Clinical assessment of venous thromboembolic risk in surgical patients. *Semin Thromb Hemost* 1991;17:304-12. https://doi.org/10.1055/s-2007-1002635
14. Lip GY, Nieuwlaat R, Pisters R, et al. Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: The euro heart survey on atrial fibrillation. *Chest* 2010;137:263-72. https://doi.org/10.1378/chest.09-1584
15. Bahl V, Hu HM, Henke PK, et al. A validation study of a retrospective venous thromboembolism risk scoring method. *Ann Surg* 2010;251:344-50. https://doi.org/10.1097/SLA.0b013e3181b7fca6
16. Hindricks G, Potpara T, Dagres N, et al. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *Eur Heart J* 2021;42:373-498. https://doi.org/10.1093/eurheartj/ehaa612. Erratum in: *Eur Heart J* 2021;42:507. Erratum in: *Eur Heart J* 2021;42:546-547. Erratum in: *Eur Heart J* 2021;42:4194.
17. Tikkinen KA, Agarwal A, Craigie S, et al. Systematic reviews of observational studies of risk of thrombosis and bleeding in urological surgery (ROTBUS): Introduction and methodology. *Syst Rev* 2014;3:150. https://doi.org/10.1186/2046-4053-3-150
18. Geerts WH, Pineo GF, Heit JA, et al. Prevention of venous thromboembolism: The Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. *Chest* 2004;126:338S-400S. https://doi.org/10.1378/chest.126.3_suppl.338S
19. Pannucci CJ, Bailey SH, Dreszer G, et al (2011) Validation of the Caprini risk assessment model in plastic and reconstructive surgery patients. *J Am Coll Surg* 212:105-12. https://doi.org/10.1016/j.jamcollsurg.2010.08.018
20. Obi AT, Pannucci CJ, Nackashi A, et al. Validation of the Caprini venous thromboembolism risk assessment model in critically Ill surgical patients. *JAMA Surg* 2015;150:941. https://doi.org/10.1001/jamasurg.2015.1841
21. Shuman AG, Hu HM, Pannucci CJ, et al. Stratifying the risk of venous thromboembolism in otolaryngology. *Otolaryngol Head Neck Surg* 2012;146:719-24. https://doi.org/10.1177/0194599811434383
22. Olesen JB, Lip GY, Hansen ML, et al. Validation of risk stratification schemes for predicting stroke and thromboembolism in patients with atrial fibrillation: Nationwide cohort study. *BMJ* 2011;342:d124. https://doi.org/10.1136/bmj.d124
23. Krasnow R, Preston M, Chung B, et al. PD58-01 Validation of venous thromboembolism risk assessment score in major urologic cancer surgery: A population-based study. *J Urol* 2017;197(4S):e1126. https://doi.org/10.1016/j.juro.2017.02.2616
24. Pannucci CJ, Swistun L, MacDonald JK, et al. Individualized venous thromboembolism risk stratification using the 2005 Caprini score to identify the benefits and harms of chemoprophylaxis in surgical patients: A meta-analysis. *Ann Surg* 2017;265:1094-103. https://doi.org/10.1097/SLA.0000000000002126
25. Borre ED, Goode A, Raitz G, et al. Predicting thromboembolic and bleeding event risk in patients with non-valvular atrial fibrillation: A systematic review. *Thromb Haemost* 2018;118:2171-87. https://doi.org/10.1055/s-0038-1675400

CORRESPONDENCE: Dr. Konstantinos Douroumis, First Department of Urology, National and Kapodistrian University of Athens, Athens, Greece; kostasdour@hotmail.com