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has been used to determine the probability of LNI. The output of these tools has assisted surgeons in determining whether to perform a PLND, and if so, to what extent [2–4]. The authors hypothesize that, with additional MRI parameters not previously used, machine-learning algorithms can better select which patients are more likely to have LNI and will therefore require extended PLND. In fact, the authors report that the MSKCC nomogram and conventional MRI reporting of LNI consistently underestimated LNI risk compared to the machine-learning-assisted models presented in their study. The outputs of the present models would allow a higher number of extended PLNDs to be spared compared to reliance on the MSKCC nomogram alone. It was appropriate to use several existing AI models in this study, as it is never readily apparent initially which existing predictive model may perform best with a given dataset. In fact, all the models used – logistic regression (LR), support vector machine (SVM) and random forrest (RF) – while similar in performance to each other, outperformed the MSKCC nomogram ($P < 0.001$). Many adjustments were probably performed for each model to tailor it to the dataset and optimize prediction performance.

Criticisms of the study are that: (i) cases for which PLND was not performed were excluded, which could have created a selection bias; (ii) the model would only be applicable when the patient has undergone MRI; (iii) the study was conducted at a single institution in a small sample (AI methods thrive on big and diverse datasets).

This study by Hou et al. is a great example of a machine-learning application that may positively impact clinical practice. For many years, we have relied on nomograms, but with increasing use of MRI, additional factors should also be included, as Hou et al. have done. Machine-learning is particularly adept at simultaneously examining numerous variables to elicit which ones may contribute best to a particular outcome. As *BJUI* has evaluated many manuscripts examining machine-learning methods for clinical decision-making in the past year, we have encouraged authors to use present-day gold standard methods, such as the MSKCC nomogram, as controls [5]. As we embrace AI methods, we must keep one eye on the tried and true conventional ways. This ensures that we do not take backward steps but rather take forward steps responsibly. Similarly to recent AI studies published in the *BJUI*, the sample size in this study was relatively small. External validation in a multicentre study on larger datasets is highly recommended.

## Conflict of Interest

None declared.

**Andrew J. Hung**

*Catherine & Joseph Aresty Department of Urology, Center for Robotic Simulation and Education, University of Southern California Institute of Urology, Los Angeles, CA, USA*

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# How long is long enough for pharmacological thromboprophylaxis in urology?

Each year, millions of patients who undergo urological surgery incur the risk of deep vein thrombosis and pulmonary embolism, together referred to as venous thromboembolism (VTE), and major bleeding. Because pharmacological prophylaxis decreases the risk of VTE, but increases the risk of bleeding, and because knowledge of the magnitude of these risks remains uncertain, both clinical practice and guideline recommendations vary widely [1]. One of the uncertainties is the recommended duration of pharmacological thromboprophylaxis. In this issue of the *BJUI*, Naik et al. [2] provide an up-to-date review that summarise the articles that examined extended thromboprophylaxis in patients with cancer who underwent radical prostatectomy (RP), radical cystectomy (RC) or nephrectomy. The outcomes on which they focussed include risks of VTE, bleeding, renal failure and mortality – all potentially influenced by whether or not patients receive extended prophylaxis.

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After screening >3500 articles, the authors included 18 studies, none of them randomised controlled trials (RCTs) [2]. They found that VTE risk is highest in open and robot-assisted RC, and that, based on observational studies, extended thromboprophylaxis significantly reduces the risk of VTE relative to shorter duration prophylaxis. Evidence suggested that robot-assisted RP, as well as both open and robot-assisted partial and radical nephrectomies, incur lower VTE risk than RCs or open RP. They did not find studies comparing extended prophylaxis to standard prophylaxis for RPs or nephrectomies [2].

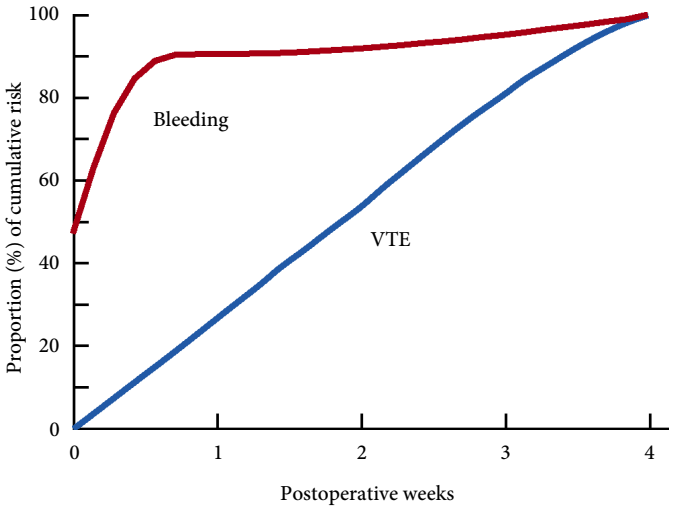
Overall, these findings are consistent with systematic reviews that estimated the procedure- and patient risk factor-specific risks for 20 urological cancer procedures [3]. As these reviews suggested substantial procedure-specific differences in the VTE risk estimates, the European Association of Urology (EAU) Guidelines provided separate recommendations for each procedure [4]. For urological (as well as gastrointestinal and gynaecological) patients, the National Institute for Health and Care Excellence (NICE) Guidelines suggest to 'consider extending pharmacological VTE prophylaxis to 28 days postoperatively for people who have had major cancer surgery in the abdomen' [5]. Because of variation in both bleeding and thrombosis risks across procedures, this advice is appropriate for some procedures and misguided for others. For instance, the procedure-specific EAU Guidelines recommend extended VTE prophylaxis for open RC but not for robot-assisted RP without lymphadenectomy [4].

The review by Naik et al. [2] identified the lack of urology-specific studies comparing the in-hospital-only prophylaxis to extended prophylaxis. The few included studies were observational with considerable limitations (e.g., limited adjustment for possible confounders).

A recent update of a Cochrane review compared the impact of extended thromboprophylaxis with low-molecular-weight heparin (LMWH) for at least 14 days to in-hospital-only prophylaxis in abdominal or pelvic surgery procedures [6]. The authors identified seven RCTs (1728 participants) evaluating extended thromboprophylaxis with LMWH and generated pooled estimates for the incidence of any VTE (symptomatic or asymptomatic) after major abdominal or pelvic surgery of 13.2% in the control group compared with 5.3% in the patients receiving extended out-of-hospital LMWH (odds ratio [OR] 0.38, 95% CI 0.26–0.54).

Most events were asymptomatic, although the incidence of symptomatic VTE was also reduced from 1.0% in the in-hospital-only group to 0.1% in patients receiving extended thromboprophylaxis (OR 0.30, 95% CI 0.08–1.11). The authors reported no persuasive difference in the incidence of bleeding complications within 3 months of surgery (defined as major or minor bleeding according to the definition provided in the individual studies) between the in-hospital-only group (2.8%) and extended LMWH (3.4%) group (OR 1.10, 95% CI 0.67–1.81).

**Fig. 1** Proportion of cumulative risk (%) of venous thromboembolism (VTE) and major bleeding by week since surgery during the first 4 postoperative weeks. Reproduced from: Tikkinen et al. [7]. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited. The Creative Commons Public Domain Dedication waiver (https://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.




These findings are consistent with our own modelling study that demonstrated an approximately constant hazard of VTE up to 4 weeks after surgery [7]. That study also found that bleeding risk, by contrast, is concentrated in the first 4 days after surgery [7] (Fig. 1). Using these findings, the EAU Guidelines suggest for patients in whom pharmacological prophylaxis is appropriate, extended pharmacological prophylaxis for 4 weeks [4]. Consistent with these recommendations, Naik et al. [2] found that 15 studies of 18 included in their review recommended extended prophylaxis.

Overall, as shown also by this review [2], the evidence base for urological thromboprophylaxis is limited. Although current evidence supports extended prophylaxis, definitively establishing the optimal duration of thromboprophylaxis will require large-scale RCTs. Other unanswered key questions include: baseline risks of various procedures, timing of prophylaxis, patient risk stratification, as well as effectiveness of direct oral anticoagulants. In the meanwhile, suggesting extended duration to patients whose risk of VTE is sufficiently high constitutes a reasonable evidence-based approach to VTE prophylaxis.

## Conflicts of interest

No financial conflicts of interest. Kari A.O. Tikkinen was chair and Gordon H. Guyatt a panel member of the EAU ad hoc Guideline on Thromboprophylaxis in Urological Surgery. Kari A.O. Tikkinen is a panel member of the American

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Society of Hematology (ASH) Guideline Panel on Prevention of Venous Thromboembolism (VTE) in Surgical Hospitalized Patients.

**Kari A.O. Tikkinen,** [*,†] **and Gordon H. Guyatt,** [‡,§]

*[*]Department of Urology, University of Helsinki and Helsinki University Hospital, [†]Department of Public Health, University of Helsinki, Helsinki, Finland, [‡]Department of Health Research Methods, Evidence, and Impact, and [§]Department of Medicine, McMaster University, Hamilton, Ontario, Canada*

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