Original research article

Effectiveness of the Padua risk assessment scale in predicting deep vein thrombosis in patients undergoing intraabdominal surgery

[1]Dr. Arunkumar Bheemanna Bhavikatti, [2]Dr. Sanikommu Mallareddy, [3]Dr. Greeshma K Masthi, [4]Dr. Kanchil G Kini and [5]Dr. Bharath G R

[1, 2, 3, 4, 5] Department of General Surgery, ESICMC PGIMSR & Model Hospital, Rajajinagar, Bangalore, Karnataka, India

Corresponding Author:
Dr. Kanchil G Kini

Abstract

Background: Venous thromboembolism (VTE) includes both pulmonary embolism (PE) and deep vein thrombosis (DVT), with leg veins accounting for approximately 90% of PE clot origins. VTE impacts roughly 1 DVT and 0.5 PE instances per 1000 persons annually, despite the fact that it is frequently asymptomatic. According to autopsy reports, 9.4% of hospitalized patients died from PE, while 34.7% of patients suffered VTE. Hospitals identify patients who pose a high risk by using rating systems. The purpose of this study is to validate the Padua risk assessment scale for DVT risk prediction.

Methods: After appropriate statistical analysis, the sample size was estimated to be 386. Patients 18 years of age and older who were scheduled for abdominal surgery participated in this study upon clearance from the institutional ethics committee. A thorough medical history, a full blood count, and a risk assessment utilizing the Padua scoring system for venous thromboembolism (VTE) were all included in the data gathering process. Patients had Venous Doppler ultrasonography on the second postoperative day in order to evaluate the deep veins. The study then evaluated the Padua scoring system's sensitivity, specificity, positive predictive value, and negative predictive value in predicting surgical patients' chance of developing VTE. Every process complies with ethical guidelines.

Results: The Padua score was shown to have a sensitivity of 80%, specificity of 74.13%, PPV of 85.10%, and NPV of 87.23% in the current study. The derived Kappa value of 0.4604 implies a moderate degree of agreement with the USG venous Doppler, which supports the validity of the Padua score in the diagnosis of deep vein thrombosis. 75.65% is the Padua percentage agreement score.

Conclusion: Patients undergoing major abdominal surgeries can use the Padua risk assessment score as an independent risk assessment tool to predict post-operative deep vein thrombosis (DVT).

Keywords: Venous thromboembolism; Padua risk assessment score

Introduction

In the context of surgical practice, lower extremity deep vein thrombosis (DVT) is a frequent condition. Since pulmonary embolism (PE) and deep vein thrombosis (DVT) have many characteristics, they have been merged to form a single clinical entity known as venous thromboembolism (VTE). More than 90% of the clots that cause PE are thought to start in the leg's deep veins. Distal veins account for 40% of the rate of involvement, popliteal veins for 16%, femoral veins for 20%, common femoral veins for 20%, and iliac veins for 4%, depending on the anatomical location. The incidence of VTE is difficult to determine in the general population due to its notoriously silent character; however, it is believed that the incidence of PE is 0.5 cases per 1000 population per year, and the incidence of DVT is 1 case per 1000 population per year. According to autopsy studies, hospitalized individuals may have a 34.7% incidence of VTE, and 9.4% of them may have a fatal pulmonary embolism.

As mentioned above, it is customary to use a scoring system to identify hospitalized surgical patients who are at risk for venous thromboembolism in order to lessen the burden of the disease and its complications. This is because PE prevention is the best way to reduce mortality, and DVT is associated with a high rate of morbidity and mortality. In order to validate the Padua risk assessment scale for estimating the risk of DVT, this study has been conducted.

Table 1: Padua Prediction Score Risk Assessment Model[a]

Baseline Features	Score
Active cancer[c]	3
Previous VTE (excludes superficial vein thrombosis)	3
Reduced mobility[d]	3
Already known thrombophilic condition[o]	3
Recent (≤1 month) trauma and/or surgery	2
Elderly age (≥70 years)	1
Heart and/or respiratory failure	1
Acute myocardial infarction or ischemic stroke	1
Acute infection and/or rheumatologic disorder	1
Obesity (BMI ≥30 kg/m²)	1
Ongoing hormonal treatment	1

Abbreviations: BMI, body mass index; VTE, venous thromboembolism.
(a) This table is based on information in reference 21 in the citation list.
(b) A total score ≥4 indicates a high risk of VTE.
(c) Includes patients with local or distant metastases and/or in whom chemotherapy or radiotherapy had been performed in the previous 6 months.
(d) Includes bed rest with bathroom privileges for at least 3 days (due to patient's limitations or per physician's orders).
(e) Includes carriage of defects of antithrombin, protein C, or protein S, or presence of factor V Leiden, antiphospholipid syndrome, or G20210A prothrombin mutations.

Methods

Prospective A cross-sectional study was conducted between September 2022 and February 2024. Patients hospitalized to the surgery departments of ESIC Medical College, PGIMSR, and Model Hospital in Rajajinagar, Bengaluru, are the source of the data. We estimated the sample size using 80% power, 95% CI, and relative precision of 5%. Based on the judgment of clinical experts, we assume that 50% of patients undergoing intra-abdominal surgery will have positive venous Doppler. The sample size was found to be 385.2, or n = 386. We used convenience sampling technique. Patients admitted to the surgical ward for abdominal surgery (laparoscopic or open) lasting longer than two hours, patients that are older than 18, and those who are prepared to sign the informed consent form meet the inclusion criteria.

Criteria for exclusion was pregnancy. The patients who met the inclusion criteria were enrolled in the study after receiving informed consent and approval from the institutional ethics committee. The study enrolled patients who had been scheduled for laparoscopic or open abdominal surgery and who were at least eighteen years of age. Following a thorough history collection and hematological examinations such as complete blood counts, data was gathered from the patients. Every patient had their Padua score calculated. Individuals got their corresponding abdominal surgeries. Every patient was subjected to a USG Venous Doppler examination of their entire deep vein system on the second postoperative day. Sensitivity, specificity, positive predictive value, and negative predictive value were computed and assessed for the Padua scoring system based on the data gathered. The Venous Thromboembolism Risk Factors were evaluated using the Padua Score. A score of less than four indicates a low risk of VTE. A score of >/= 4 indicates a high risk of VTE.

The gathered data was entered in Microsoft Excel and examined. In order to summarize quantitative factors like the patient's age and Padua score, descriptive statistics like mean and standard deviation, median with IQR, and graphs were used. Frequency and percentage analysis with graphs were used to examine qualitative or categorical variables such as the type of surgery, diagnosis, and sex of the patient. To evaluate the Padua score with USG Venous Doppler, sensitivity and specificity analyses were done. The data was analyzed using the statistical software Statistical Package for Social Science (SPSS) 20.

Results

A total of 386 patients who met the inclusion criteria were studied over a period of 1.5 years. The study included 223 male and 163 female patients with a ratio of 1.1: 1. (Table 2).

Table 2: Gender Distribution of Patients in the Study Over 1.5 Years

Gender	No of patients	% of patients
Male	223	57.8
Female	163	42.2
Total	386	100

The maximum number of patients in our study underwent exploratory laparotomy (n = 105, 27%), followed by open hernia mesh repair (n = 66, 17%), and laparoscopic cholecystectomy (n = 58, 15%)

(Table 3).

Table 3: Types of Procedures Performed on Patients in the Study

Type of procedure	N	Percentage
Exploratory laparotomy	105	27
Open hernia mesh repair	66	17
Lap cholecystectomy	58	15
Freys procedure	25	6
Lap fundoplication	14	3
Hemicolectomy	39	10
Gastrectomy	31	8
Abdomioperineal resection	17	4
Whipples procedure	5	1.2
Lap hernia repair	6	1.5
Hepaticojejunostomy	4	1.0
Oophrectomy	8	2.2
Splenectomy	3	0.7
Nephrectomy	5	1.2
Hepatectomy	8	2.2

In our study, patients who have been receiving treatment within the last 6 months were considered to have active cancer. It was seen that 21 (5.4%) patients had cancer and 365 (94.6%) did not have cancer. (Table 4).

Table 4: Presence of active cancer among patients in the study

Active cancer	Frequency	%
Yes	21	5.4
No	365	94.6
Total	386	100

In our study, it was found that 40 patients had a previous history of thromboembolism and 346 patients had no such history. (Table 5).

Table 5: Previous history of venous thromboembolism among patients in the study

Previous history of venous thromboembolism	Frequency	%
Yes	40	10.4
No	346	89.6
Total	386	100

In our study, patients with immobilization > 3 days were considered to have reduced mobility. It was found that 95 patients had reduced mobility and 291 patients had normal, regular mobility. (Table 6).

Table 6: Reduced mobility among patients in the study

Reduced mobility	Frequency	%
Yes	95	24.6
No	291	75.4
Total	386	100

In our study, it was found that 0 patients had h/o thrombophilic condition. In our study, patients undergoing major surgery requiring regional or general anesthesia in the past 3 months were considered for past history of surgery. It was found that 143 patients had a history of trauma/surgery, and 243 had no history. (Table 7).

Table 7: Past history of trauma/surgery among patients in the study

Past history of trauma/surgery	Frequency	%
Yes	143	37
No	243	63
Total	386	100

In our study, 11 patients were above age 70 years, and the remaining 375 were below age 70 years. (Table 8).

Table 8: Age distribution of patients above and below 70 years

Age > 70 yrs	Frequency	%
Yes	11	2.8
No	375	97.2
Total	386	100

In our study, 114 patients had heart/respiratory failure and the remaining 272 had no failure. (Table 9).

Table 9: Prevalence of heart/respiratory failure among patients in the study

Heart/Respiratory failure	Frequency	%
Yes	114	29.5
No	272	70.5
Total	386	100

In our study, 34 patients had MI and 352 patients had no MI. (Table 10).

Table 10: Incidence of acute myocardial infarction (MI) among patients in the study

Acute MI	Frequency	%
Yes	34	8.8
No	352	91.2
Total	386	100

In our study, patients with Systemic Inflammatory Response Syndrome (SIRS) scored > 2 was considered having an acute infection. It was seen that 125 patients had acute infection and 261 patients didn't have acute infection (Table 11).

**Table 11:** Presence of acute infection among patients in the study

Acute infection	Frequency	%
Yes	125	32.4
No	261	67.6
Total	386	100

In our study, patients having a BMI > 30 kg/m^2 were considered obese. It was seen that 159 patients were obese and 227 patients were not obese.

Table 12: Obesity status among patients in the study

Obesity	Frequency	%
Yes	159	41.2
No	227	58.8
Total	386	100

Of the 159 patients who were obese, 156 patients had BMI ranging 30-35, and 3 patients had BMI ranging 35.1-40 (Graph 1).
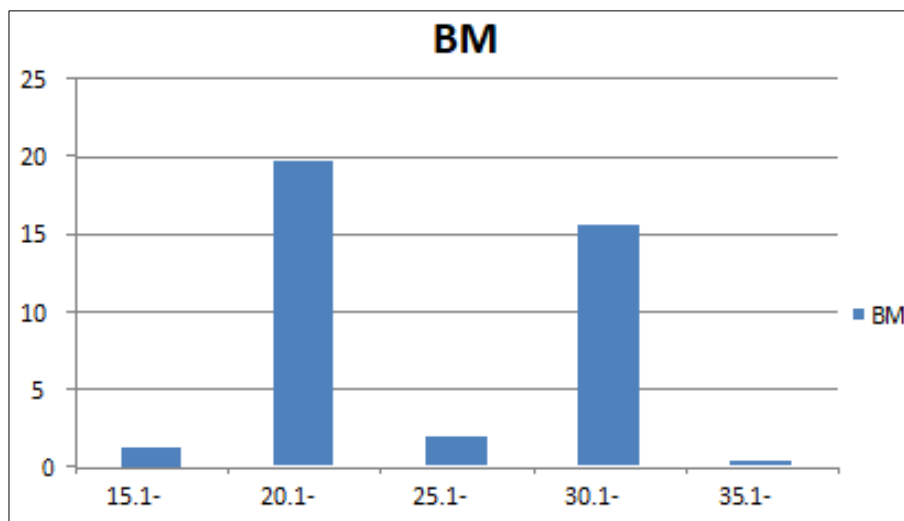
Graph 1: Distribution of Obese Patients by BMI Ranges

In our study, 1 patient was on HRT; she was taking estrogen and progesterone pills; the other 384 patients were not on HRT. (Table 13).

Table 13: Hormone replacement therapy (HRT) status among patients in the study

HRT	Frequency	%
Yes	1	0.3
No	384	99.7
Total	385	100

The number of patients with deep vein thrombosis according to the Padua risk assessment score was 154 (39.9%) (Table 14).

Table 14: Incidence of Deep Vein Thrombosis (DVT) Based on Padua Risk Assessment Score

Padua risk assessment score	Patients	%
DVT	154	39.9
No DVT	232	60.1
Total	386	100

In our study, 100 patients were found to have DVT on Doppler; 177 patients did not have DVT. (Table 15)

Table 15: Detection of Deep Vein Thrombosis (DVT) via USG Venous Doppler

USG Venous Doppler	Frequency	%
DVT	100	25.9
No DVT	286	74.1
Total	386	100

Table 16: Shows the assessment of agreement between USG Venous Doppler and Padua risk assessment score

		USG Venous doppler		Total
		DVT	No DVT	
Padua Risk Assessment score	DVT	80	36	116
	No DVT	20	142	162
	Total	100	178	278

In our study, the sensitivity, specificity, negative predictive value, and positive predictive value of the Padua assessment score were 80%, 74.13%, 85.10%, and 87.23%, respectively. (Table 17).

Table 17: Diagnostic Performance of the Padua Risk Assessment Score

Padua Risk Assessment score	Value
Sensitivity	80.00%
Specificity	74.13%
Positive predictive value	85.10%
Negative predictive value	87.23%

Discussion

This study examined the utility of the Padua score for predicting DVT in patients who were admitted to the hospital to undergo abdominal surgeries from September 2022 to February 2024. Padua score has been in use for more than a decade and has a predictive value in determining DVT risk in hospitalized medical patients, but its efficacy specifically in surgical patients has not been studied. The simple 20-point RAM adopted clearly discriminated between hospitalized surgical patients at high and low risk of VTE complications. Since it was an observational study, we observed the outcome of the patients in terms of the development of DVT.

In our study, 100 out of 386 patients developed DVT, and prompt treatment according to ACCP (American College of Chest Physician) guidelines was initiated. Recognizing the significance of devising individual risk assessment models to forecast VTE occurrences among both hospitalized and non-hospitalized individuals, various assessment frameworks have been put forward. These models typically integrate numerous risk factors such as age, gender, underlying health conditions, and the nature of the presenting illness. However, unanimity remains elusive regarding the most reliable predictor for DVT [1].

In a study by Chen XL et al. [2], the use of the Padua model to predict DVT in surgical patients reported findings with a sensitivity of 85% and a specificity of 63%, whereas in our study it was found that the sensitivity of the Padua score was 80.00% and the specificity was 79.77%, which shows sensitivity on the lower side and higher specificity.

Table 18: Comparison table of validity of Padua score with others [4, 5]

DVT scores	Sensitivity	Specificity
Wells score	81%	80.65%
Caprini score	61.1%	66.7%
Padua score (present study)	80.00%	74.13%
Khorana score	75%	60%
IMPROVE score	64%	60%

The comparison of various scoring systems to diagnose DVT, as mentioned in the above table, reveals that the sensitivity of the scoring system ranges between 61 and 81% and the specificity ranges between 60 and 80%.

Sensitivity of Padua scores better than other scores except for Wells score, where specificity of Padua score is higher compared to Caprini score and almost equal with Wells score.

The calculated Kappa value of 0.4604 signifies moderate agreement with the USG venous Doppler, reaffirming the Padua score's validity in identifying deep vein thrombosis. The percentage agreement of the Padua score is 75.65%.

Conclusion

Our study finding the effectiveness of the Padua risk assessment score for DVT came out with the following conclusion.

- Padua risk assessment score can be independently applied as a risk assessment tool to predict post-op DVT in patients undergoing major abdominal surgeries.
- The strength of our study is that our sample size was 386 undergoing a wide spectrum of abdominal surgeries.
- More randomized control trials and multicentre trials are to be undertaken to study the effectiveness of the Padua Risk Assessment Score.

Declarations

Conflict of interest: We declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical approval: Approved.

References

1. Łukaszuk RF, Dolna-Michno J, Plens K, Czyżewicz G, Undas A. The comparison between Caprini and Padua VTE risk assessment models for hospitalized cancer patients undergoing chemotherapy at the tertiary oncology department in Poland: Is pharmacological thromboprophylaxis overused? Contemp Oncol (Pozn). 2018;22(1):31-36. DOI: 10.5114/wo.2018.74391. Epub 2018 Apr 3. PMID: 29692661; PMCID: PMC5909728.
2. Chen X, Pan L, Deng H, Zhang J, Tong X, Huang H, *et al*. Risk assessment in Chinese hospitalized patients comparing the Padua and Caprini scoring algorithms. Clin. Appl. Thromb. Hemost. 2018 Dec;24(9):127S-135S.
3. Barbar S, Noventa F, Rossetto V, Ferrari A, Brandolin B, Perlati M, *et al*. A risk assessment model for the identification of hospitalized medical patients at risk for venous thromboembolism: the Padua Prediction Score. J Thromb. Haemost. 2010 Nov 1;8(11):2450-2457.
4. Gatot D, Mardia AI. Differences of wells scores, accuracy, Caprini scores, and Padua scores in deep vein thrombosis diagnosis. In: IOP Conference Series: Earth and Environmental Science. 2018 Mar 1;125(1):012131.
5. Cohen H, Cuadrado MJ, Erkan D, Duarte-Garcia A, Isenberg DA, Knight JS, *et al*. 16th international congress on antiphospholipid antibodies task force report on antiphospholipid syndrome treatment trends. Lupus. 2020 Oct;29(12):1571-1593.