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Comparison of the Pauda and the Autar DVT Risk Assessment Scales in Prediction of Venous Thromboembolism in ICU Patients

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Abstract

Background: The evaluation of VTE risk using risk assessment scales for each hospitalized patient is recommended by the National Institute for Health and Care Excellence. The purpose of this study was to compare the predictive accuracy of two common assessment scales, the Autar and Padua deep vein thrombosis (DVT) risk assessment scales.

Methods: This prospective cohort study was conducted on 228 ICU hospitalized patients. The risk of VTE was estimated using the Autar and Padua scales during the first 48 hours after admission. The predictive accuracy of the above two risk assessment scales for VTE in ICU patients was compared based on the area under the receiver operating curve (ROC).

Results: Results of ROC analysis indicated the area under the curve (AUC) values for the Autar (0.61 ± 0.05) and Pauda (0.53 ± 0.06). Log-rank test showed no difference in AUCs (P = 0.19). Moreover, the accuracy of the Autar scale and Padua obtained 24% and 14% respectively. Both scales had 100% sensitivity but their specificity was low (Autar 14% and Padua 3%). The positive likelihood ratios (LR+) were 1.17 for Autar and 1.03 for Padua. The negative likelihood ratios (LR-) were 0 for Autar and 0.89 for Padua. Inter-rater agreement values obtained 0.99 and 0.95 respectively for the the Autar and Padua scales.

Conclusion: The AUC, accuracy, and LR+ of the Autar risk assessment scale were higher than the Padua scale in predicting VTE. However, both scales had excellent reliability, high sensitivity and low specificity. It is recommended that the risk of VTE is recorded by the Autar scale for patients admitted to ICUs. It can help the healthcare team in the use of prophylaxis for those that are at high risk for VTE.

Keywords: DVT, PE, VTE, Autar risk assessment scale, Padua DVT risk assessment scales

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Introduction

Venous thromboembolism (VTE) is a significant health problem worldwide among hospitalized patients (1). It manifests as deep vein thrombosis (DVT), pulmonary embolism (PE), or both (2). The mean annual incidence rate of VTE has been reported between 129.90 and 395.16 cases per 1000 among hospital admissions in the Iranian population (3) and 104-183 per 100,000 in European people (4). Patients hospitalized in intensive care units (ICUs) are at high risk of VTE due to several risk factors specific to the ICU, including prolonged immobility, mechanical ventilation, cardiac or renal failure, central catheters, and sedatives (5). These risk factors increase the risk of

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↑What is "already known" in this topic:
VTE is a life-threatening complication in ICUs. Patients in the ICUs are at high risk of VTE due to immobilization, mechanical ventilation, and central catheters. Thus clinical assessment tools that could predict VTE risk are important. However, the predictive accuracy of the two common scales (Autar and Padua) is still unclear in terms of clinically assessing the VTE risk in ICUs patients.

→What this article adds:
Our study suggests that the Autar DVT Risk Assessment Scale is a practical and effective tool to assess in predicting the risk of occurrence VTE in ICUs patients.

thromboembolic events in the ICU (6). The mortality associated with VTE in the general population is reported to be 10–30% within the first 30 days after diagnosis (7). Therefore, managing VTE as a life-threatening condition is vital for decreasing mortality and morbidity.

The primary goal in managing VTE is to prevent the development of thrombosis. Preventive treatments are pharmacological prophylaxis that targets hypercoagulability (8) and mechanical methods that act on venous stasis (9). Mechanical thromboprophylaxis includes early ambulation, graduated compression stockings, and intermittent pneumatic compression devices (10). Despite the importance of prevention, approximately 50% of hospitalized patients do not receive DVT prophylaxis. In addition, the usage of medication prophylaxis is low in Asian countries (11). Thus, predicting the risk of developing VTE using clinical assessment tools could help to prevent VTE and to select the most effective management according to the risk level.

Diagnosis of VTE in ICU is challenging because it has nonspecific signs and symptoms. Also,it could be hampered due to the difficulties of moving these critically ill patients for imaging procedures (12). Thus, stratifying ICU patients into the high and low clinical probability of VTE development using clinical risk assessment tools at the bedside is noteworthy. On the other hand, implementing such assessment tools can reduce the need for imaging, prevent unnecessary anticoagulant drugs, avoid bleeding, and be helpful in the diagnosis and treatment of these patients (13).

There are several clinical risk assessment tools to identify the VTE risk in hospitalized patients, but consensus about the best of them is lacking (14). The Autar and Padua scales are two DVT risk assessment tools frequently used in hospital patients (15). The Autar DVT scale was developed based on Virchow's triad: venous stasis, activation of blood coagulation, and vein wall injury. It consists of seven subcategories of risk factors, which often apply in diverse clinical settings (16). The Padua scale is a risk assessment score that consists of 11 risk factors, ranging from 0 to 20 (17). The Padua is commonly used to examine the risk of VTE in hospitalized patients (18).

The assessment of VTE risk for each hospitalized patient and evaluation of the accuracy of the risk assessment tools are emphasized by the National Institute for Health and Care Excellence (NICE). However, there is an information scarcity regarding the accuracy of the scales mentioned above when used in different hospital settings (19). So far, research evidence has been shown that the predictive values of the Autar and Padua scales are sufficient for determining the risk of VTE in patients with solid tumors (20). A sensitivity of 70% was found for the Autar scale when used for trauma and orthopedic patients (21). Moreover, Barbar et al. indicated that the Padua scale could discriminate between patients at high and low risk of VTE (18). Nevertheless, sensitivity, specificity, and accuracy of these scales for ICU patients are not evident yet. Thus, the purpose of this study was to examine and compare the predictive accuracy of the Autar and Padua DVT risk assessment scales in ICU patients.

Methods

Study Design and Participants

This prospective cohort study assessed the VTE risk in patients hospitalized in the ICU wards of a local hospital (a 7١٨-bed teaching hospital of Jundishapur University of Medical Sciences, Ahvaz, Iran) using simple random sampling between March 2021 and April 2022. Patients were included if they were ≥18 years old and stayed more than two days in the ICU from the admission date. The ones with diagnosed DVT and/or PE or active bleeding, the use of therapeutic anticoagulation before or within 48 hours of ICU admission were excluded. The Ethics Committee approved the study of Jundishapur University of Medical Science, Ahvaz, Iran (No: IR.AJUMS.REC.1399.834). All study subjects or their legal guardians signed informed consent.

Data collection

First, demographic information, including age, gender, and body mass index (BMI) was recorded for patients who met the criteria. Afterward, the risk of DVT in patients was examined using the Persian versions of the Autar and Padua scales within the first 48 hours of admission by a physical therapist (22, 23). The Autar DVT scale consists of seven subcategories of risk factors, such as age-specific group, BMI, mobility/immobility, special risk, trauma risk, surgical intervention, and high-risk diseases. In each category, risk factors are scored based on importance from 0 to 7 (2–3: low to moderate and ≥4: very high risk of DVT)(17). The overall score was calculated from the addition of all categories. The risk of VTE for one individual was determined based on the following classification system: No risk ≤6, Low (7–10), moderate (11–13), and high risk ≥15 (16, 21). The Padua scale includes 11 risk factors, each item scoring from 1 to 3. The total score was assessed for each patient, with a score of <4 indicating low risk and a score ≥4 indicating high risk of developing VTE. Patients were followed for three months to see if VTE occurred. They were monitored by phone every two weeks. VTE includes DVT in the upper or lower extremity, PE, or both that was diagnosed based on clinical suspicion and was confirmed using venous Doppler ultrasound or chest CT scan by a physician . The Persian versions of the Autar and Padua scales' reliability were assessed before data collection during the preliminary study. Two physical therapists scored VTE risk in 56 subjects using both scales to assess inter-rater reliability. Additionally, the two raters were unaware of each other's scores. The sample size was determined based on the pilot study information for AUC variable. The following formula was applied to calculate the sample size $n = \frac{Z^2_{\alpha/2} V(AUC)}{d^2}$, where: AUC= 0.70, V(AUC)=0.145, and alpha level =0.05 which obtained a sample size of 223.

Statistical Analysis

All statistical analysis was performed using SPSS version 22 (IBM Corp., Armonk, NY, USA)**.** The quantitative variables were described by the mean±standard deviation (SD), and the categorical variables were presented by fre-

quency (percentage). Participants were divided into two subgroups based on the occurrence of DVT. The Chi-square test was used to compare the categorical variables between the two groups. Furthermore, the T-test and Mann-Whitney U test were implemented to compare quantitative variables between the groups. In addition, the $P < 0.05$ was considered statistically significant, and intraclass correlation coefficients (ICC) were used to determine the inter-rater reliability of the two scales. The ICC is a value between 0 and 1, where values below 0.5 indicate poor reliability, between 0.5 and 0.75 moderate reliability, between 0.75 and 0.9 good reliability, and any value above 0.9 indicates excellent reliability (24). The predictive accuracy of two VTE risk assessment tools was compared based on the area under the receiver operating characteristic (ROC) curve, sensitivity, specificity, positive likelihood ratio (LR−), negative likelihood ratio(LR+) and accuracy. The area under the curve (AUC) is an effective way for interpreting the interpretation of overall diagnostic accuracy of a test that ranges in values from 0.9–1.0 excellent, 0.8-0.9 very good, 0.7-0.8 good, 0.6-0.7 sufficient, 0.5-0.6 bad, and <0.5 test not useful (25). An LR+ greater than 1 supports the presence of the disease, and the greater the LR+ is, the more a positive test result increases the probability of the disease when compared with the pretest probability. LR− ranges from 1 to 0, and the closer the LR is to 0, the lower the probability of the disease is if the test result is negative (26). Two AUCs were compared with the log-rank test.

Results

Three hundred and eight patients hospitalized in the general ICU wards were included in this study. Overall, 252 cases met the eligibility criteria. During the study, 24 patients dropped out due to death (n=11), unwillingness to participate in the follow-up (n=7), and personal problems (n=6). The data of the remaining 228 participants (146 males and 82 females) were collected and analyzed. Among 228 patients, 26 developed VTE, including DVT (n =20), PE (n = 5), and DVT + PE (n=1). Table 1 depicts the demographic features of the VTE and non-VTE groups. No significant difference was found in age, gender, and BMI. Nevertheless, the length of ICU stay was significantly higher in the VTE group than in the no-VTE group. Based on the Autar scale in this study, complete bed rest, age > 60 years, neurological surgery, and cerebrovascular accident were the main risk factors for VTE development in study participants.

The distribution of risk levels for all ICU patients with the Autar and Padua are shown in Table 2. According to the Autar scale, 80.76% (n=21) of the VTE people were classified as the high-risk level and 19.23% (n=5) as moderate risk. The Padua scale classified all the VTE study populations as high risk.

The ROC curves and AUC values of two scales that determine accuracy in predicting two scales for VTE development are shown in Figure 1. Results of ROC analysis indicated the AUC values for the Autar (0.61 ± 0.05) and Pauda (0.53 ± 0.06). Moreover, the accuracy of the Autar scale and Padua were obtained at 24% and 14%, respectively. Both questionnaires had excellent sensitivity but low specificity (Autar: 14%, Padua: 3%). Two AUCs were compared with the log-rank test (p=0.192). The positive likelihood ratios were 1.17 for Autar and 1.03 for Padua. The negative likelihood ratios were 0 for Autar and 0.89 for Padua (Table 3). Inter-rater agreement values obtained 0.99 and 0.95 respectively for the Persian version of the Autar and Padua scales, it presented exellent reliability.

Table 1. Demographic and clinical characteristics of VTE and no-VTE groups

variable	VTE group n=26	no VTE n=202	*P*-value
Age (years)	55.15±34.99	51.08±18.73	0.317
Gender (Female/male)	10/16	72/130	0.468
Body Mass Index (Kg/m2)	24.92±6.28	23.40±4.03	0.562
Length of stay in ICU (days)	28.57±16.87	17.08±10.84	0.001

Table 2. The risk score of the two groups with the Autar and Padua scale

Scale		No-risk	Low-risk	Moderate risk	High risk	The risk score of the VTE group	The risk score of the no-VTE group	*P*-value
Autar	All patients n=228	6 (%2.6)	23 (%10.1)	58 (%25.4)	141 (%61.8)	17 (3.16)	15.22 (4.22)	0.069
	Patients with VTE n=26	-	-	5 (%19.23)	21 (%80.76)			
Padua	All patients n=228	-	6 (%2.6)	-	222 (%97.4)	7.84(1.54)	7.60 (1.78)	0.613
	Patients with VTE n=26	-	-	-	26 (%100)			

Table 3. Comparison of the two scales in predicting the occurrence risk of venous thromboembolism in hospitalized ICU patients

Scale	AUC (95% CI)	Sensitivity	Specificity	Positive likelihood ratio	Negative likelihood ratio	Accuracy
Autar	0.61 ± 0.05 (0.49-0.72)	100%	14%	1.17	0	24%
Padua	0.53 ± 0.06 (0.41-0.66)	100%	3%	1.03	0.89	14%

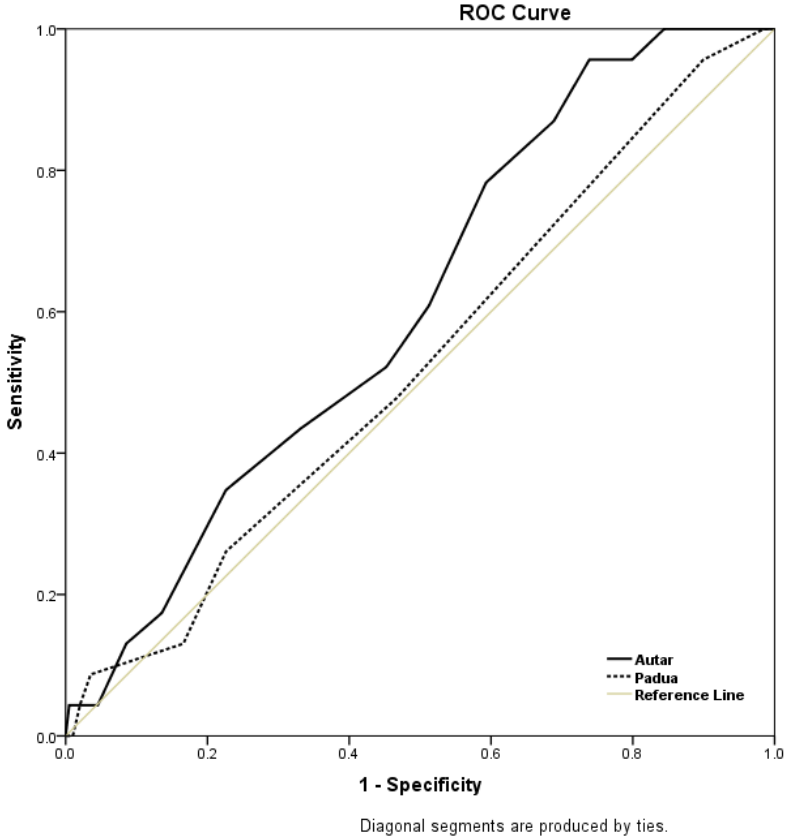

Figure 1. The ROC curves and AUC Value of Autar and Padua risk assessment tools scales

Discussion

This study aimed to draw a comparison between the predictive accuracy of the Autar and Padua VTE risk assessment scales in a sample of patients hospitalized in ICU, which is the first study to compare the predictive validity of two common risk assessment scales in ICU patients. The result indicated that the Autar scales had a good performance in predicting VTE in the ICU patients, considering the AUC value compared to the Padua scale.

There are some reasons that the Atuar scale is more appropriate and practical for estimating the clinical probability of VTE in ICU patients than Padua. The Autar scale considers diverse clinical areas and a more complex scoring system for predicting the overall risk of VTE. For instance, some surgical interventions are associated with higher VTE risk, such as orthopedic and neurological surgeries, than others (16). This fact is considered in the Autar scoring system. Moreover, the location of trauma may affect the development of VTE. To illustrate the point, lower limb trauma is a higher risk for VTE development than head trauma. While surgery and trauma are considered risk factors in the Padua scale, sub-classifications of these factors are not regarded. Furthermore, the Autar scale classifies the age into five subscales, considering that VTE incidence rises exponentially with age. Yet, only ages of ≥ 70 years are included as a risk factor in the Padua scale, and other age groups are ignored (27, 28). In line with our result, Wange et al. examined the predictive value of four different risk assessment scales (Caprini, Autar, Pauda, and Khorana scales) for DVT in patients with solid tumors by ROC and obtained higher AUC values for Autar and Padua (between 0.6 and 0.7) respectively (29). Ashrafi et al. compared the Autar DVT risk assessment scale with modified Wells criteria in predicting DVT in patients with lower extremity trauma. They recommended that the Autar scale was more precise compared to modified Wells for DVT predictions (22). However, Feifan et al. reported all five thrombosis risk assessment scales (Wells, Capprini, RAPT, Autar and Pauda) have certain predictive values for the occurrence of deep vein thrombosis in the lower extremity of hospitalized patients with an intertrochanteric fracture (30). It seems that the predictive ability of thrombosis risk assessment scales is different in different populations.

This research had some limitations. First, the predictive accuracy of the Autar and Padua scales was assessed in a single center, and patients were admitted to the general ICUs. Therefore, the generalizability of the current study is limited to similar groups. It suggests future studies evaluate the validity of these two VTE risk assessment scales in multicenter and patients admitted to specialized ICUs such as neurologic ICUs and other hospital wards. Second, We considered symptomatic VTE. Thus asymptomatic VTE was not detected. Third, we did not capture the association between the occurrence of VTE and the duration of mechanical ventilation, immobilization and central venous catheterization placement. It suggests that future studies investigate the association of these factors

with the risk of VTE.

Conclusion

In conclusion, the AUC and accuracy of the Autar risk assessment scale were higher than the Padua scale in predicting VTE in ICU patients. However, both scales had excellent reliability, high sensitivity and relatively low specificity.

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Conflict of Interests

The authors declare that they have no competing interests.

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