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Role of three commonly used scoring systems in prediction of pulmonary thromboembolism in Xining area

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Abstract. – OBJECTIVE: To analyze the clinical values of three commonly used scoring systems including Wells score, revised Geneva score and Pisa score in predicting pulmonary thromboembolism (PTE) in Xining area.

PATIENTS AND METHODS: A total of 67 patients who had received CT pulmonary angiography (CTPA) in Qinghai Provincial People's Hospital from January 1, 2008 to July 31, 2010 due to suspected acute PTE were enrolled in this study. Among them 30 were confirmed to be with acute PTE and 37 were excluded. The risk of PTE was evaluated using the Wells score, the revised Geneva score, and Pisa score in all these patients. Clinical values of these scoring systems in diagnosis of PTE were compared using the receiver operating characteristic (ROC) curves; and CTPA values as the standard. The diagnostic accuracies were also compared.

RESULTS: The probability of PTE was 33.3% (14/42) when the Wells score was < 2, 89.47% (17/19) when the Wells score was 2-6, and 100% (6/6) when the Wells score was above 6. The probability of PTE was 31.71% (13/40) when the revised Geneva score was 0-3, 85.0% (17/20) when the revised Geneva score was 4-10, and 100% (7/7) when the revised Geneva score was ≥ 11, suggesting that PTE might be associated with the revised Geneva score ($p < 0.001$). When Pisa score was used, the probability of PTE was 20.59% (7/34), at ≥ 10%, 76.92% (10/13), at 10% to 90%, and 100% (20/20) at > 90% score. The AUCs for all three scoring systems showed significant differences ($p < 0.05$).

CONCLUSIONS: Thus, the Pisa score showed a relatively higher clinical value in Xining area to predict clinical probability of PTE in patients, with its overall sensitivity and specificity being higher than the Wells and revised Geneva score.

Key Words:
Pulmonary thromboembolism, Clinical score, Xining area.

Introduction

Pulmonary thromboembolism (PTE) is a relatively common and potentially fatal disorder. A study conducted on the standardized diagnosis and treatment of PTE in 40 hospitals in China has demonstrated that PTE is not an uncommon disease[1]. However, due to its nonspecific clinical features and laboratory findings, PTE is often missed or misdiagnosed. In recent years, using bedside non-invasive methods, some clinical scoring systems including the Wells score, the revised Geneva score, and the Pisa score have been introduced for the diagnosis of PTE. While these clinical scoring models have been widely validated in foreign literature, few clinical studies have been conducted in China, particularly in Xining, an area of moderate altitude (2,260 m). In current study, we analyzed the clinical values of three commonly used scoring systems including Wells score, revised Geneva score, and Pisa score in predicting pulmonary thromboembolism (PTE) in Xining area.

Patients and Methods

General Data

Patients who had received CT pulmonary angiography (CTPA) in Qinghai Provincial People's Hospital from January 1, 2008 to July 31, 2010 due to suspected acute PTE were enrolled in this study. The CTPA findings were regarded as the golden standards. Among these subjects, there were 37 PTE patients (23 men and 14 women) aged 36-90 years (mean: 60.89 ± 15.03 years) but four of them died during the course of study. Thirty non-PTE patients (22 men and 8 women) aged 17-80 years (mean: 53.8 ± 17.42 years) also participated in the study.

Methods

Clinical data including gender, age, clinical symptoms and signs, chest X-ray findings, and electrocardiography (ECG) results were collected for all the patients, and Wells score, revised Geneva score, and Pisa score were applied for

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the prediction of PTE. A Wells score of < 2 indicates a low probability, score of 2-6 indicates a moderate probability, and > 6 indicates a high probability of PTE. A revised Geneva score of < 3 indicates a low probability, 4-10 indicates a moderate probability, and >10 indicates a high probability of PTE. A Pisa score of ≤ 10% indicates a low probability, 10%-90% indicates a moderate probability, and > 90% indicates a high probability of PTE.

CT Examination and Image Analysis

CT examinations using a LightSpeed 64-slice spiral CT scanner (GE, USA) were completed upon admission or within 24 hours after admission. The CPTA images were introduced into the workstation for further analysis. The diagnostic criteria for acute PTE are as follows: central or eccentric low-density filling defects found in the contrast-enhanced pulmonary artery, with the arterial diameters being normal or widened.

Statistical Analysis

The measurement data were analyzed using SPSS 17.0 software (SPSS Inc., Chicago, IL, USA) and expressed as mean ± standard deviations and medians (interquartile range) and analyzed using t-test and rank sum test. The enumeration data were described using relative number and analyzed using chi-square test. The values of these three scoring systems in diagnosing PTE were evaluated using the Receiver Operating Characteristic (ROC) curves. The areas under the curve (AUCs) were calculated; and are presented as A ± SE and compared with Z test, with the test level $p < 0.05$.

Results

Evaluations Done with the Wells Score, Revised Geneva Score, and Pisa Score

All 37 PTE patients and 30 non-PTE patients underwent evaluations with the Wells score, revised Geneva score, and Pisa score for the clinical cut-off values for the probability of PTE. The scoring results are presented as medians (interquartile range). Differences between the PTE and non-PTE groups were statistically significant ($p < 0.05$) (Table I).

The Probability of PTE Based on Cut-Off Values of the Wells Score

Based on the cut-off values of the Wells score in predicting the probability of PTE, it was 33.35% (14/42) when the Wells score was < 2, 89.47% (17/19) when the Wells score was 2-6, and 100% (6/6) when the Wells score was above 6, suggesting that a higher Wells score was associated with an increased probability of PTE ($p < 0.001$) (Table II).

The Probability of PTE Based on Cut-Off values of the Revised Geneva Score

The probability of PTE was 31.71% (13/41), when the revised Geneva score was 0-3, 85.0% (17/19), when the revised Geneva score was 4-10, and 100% (7/7) when the revised Geneva score was ≥ 11, suggesting that PTE might be associated with the revised Geneva score ($p < 0.001$) (Table III).

The Probability of PTE Based on Cut-Off Values of the Pisa Score

The probability of PTE was 20.59% (7/34) when the Pisa score was ≤ 10%, 76.92% (10/13) when the Pisa score was 10-90%, and 100% (20/20) when the Pisa score was >90%. Thus, the increased Pisa score represents the increased probability of PTE ($p < 0.001$) (Table IV).

Area Under Curves (AUCs) for the Scoring Systems

The AUC for the Wells score was 0.716 ± 0.066 ($p = 0.003$), with a sensitivity of 62.16%

Table I. Scoring results in the PTE and non-PTE groups [M (QU-L)].

Group	n	Clinical scores of PTE		
		Wells score	Revised Geneva score	Pisa score
PTE group	37	3 (1,5.25)	7 (2,9)	1 (0.3,1)
Non-PTE group	30	1.5 (1,1.5)	2 (0.75,3)	0.1 (0.2,0)
Z value		-3.067	-4.113	-5.464
p value		0.002	0.000	0.000

Table II. Relationship between the Wells score and the probability of PTE.

Score	n	PTE	Non-PTE	PoP (%)
0.0	13	7	6	53.85
1.0	12	5	7	41.67
1.5	17	2	15	11.76
2.5	3	2	1	66.67
3.0	5	4	1	80.00
4.0	3	3	0	100.00
4.5	4	4	0	100.00
5.0	1	1	0	100.00
5.5	3	3	0	100.00
6.5	3	3	0	100.00
7.0	3	3	0	100.00
Total	67	37	30	55.22

PTE: pulmonary thromboembolism; PoP: probability of PTE; PTE distribution test $\chi^2 = 20.682$, $p < 0.001$.

Table III. Relationship between the revised Geneva score and the probability of PTE.

Score	n	PTE	Non-PTE	PoP (%)
0.0	11	4	7	36.36
1.0	8	3	5	37.50
2.0	10	3	7	30.00
3.0	12	3	9	25.00
4.0	3	1	2	33.33
5.0	1	1	0	100.00
6.0	2	2	0	100.00
7.0	7	7	0	100.00
8.0	3	3	0	100.00
9.0	2	2	0	100.00
10.0	1	1	0	100.00
11.0	1	1	0	100.00
12.0	1	1	0	100.00
13.0	2	2	0	100.00
14.0	1	1	0	100.00
15.0	1	1	0	100.00
16.0	1	1	0	100.00
Total	67	37	30	55.22

PTE: Pulmonary thromboembolism; PoP: probability of PTE; PTE distribution test $\chi^2 = 20.682$, $p < 0.001$.

and a specificity of 80.0%; The AUC for the revised Geneva score was 0.791 ± 0.057 ($p < 0.001$), with a sensitivity of 64.87% and a specificity of 93.33%; The AUC for the Pisa score was 0.962 ± 0.027 ($p = 0.027$), with a sensitivity of 81.08% and a specificity of 96.67%. Thus, the AUCs for the three scoring systems showed significant differences ($p > 0.05$) (Figure 1 and Table V).

Table IV. Relationship between the Pisa score and the probability of PTE.

Score (%)	n	PTE	Non-PTE	PoP (%)
0	14	2	12	14.29
10	15	5	10	33.33
20	4	1	3	25.00
30	4	2	2	50.00
40	2	1	1	50.00
50	2	1	1	50.00
60	2	1	1	50.00
70	1	1	0	100.00
80	1	1	0	100.00
90	2	2	0	100.00
100	20	20	0	100.00
Total	67	37	30	55.22

PTE: Pulmonary thromboembolism; PoP: probability of PTE; PTE distribution test $\chi^2 = 20.682$, $p < 0.001$.

Discussion

The PTE were usually missed or misdiagnosed before death[2]. CT pulmonary angiography (CTPA) remains the optimal non-invasive imaging method for confirming PTE[3]. However, the diagnosis of PTE, to a large extent, still depends on the judg-

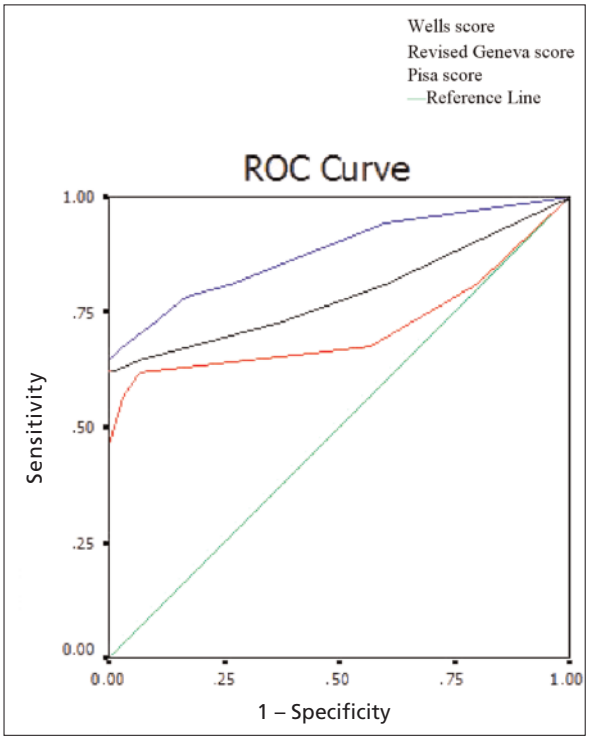

Figure 1. The Receiver Operating Characteristic (ROC) curves of the Wells score, revised Geneva score, and Pisa score for the prediction of probability of PTE.

Table V. Scoring results in the PTE and non-PTE groups.

	PTE group (n)	Non-PTE group (n)	Sensitivity (%)	Specificity (%)	Youden's index (%)	Coincidence rate (%)	Consistency rate(%)
Wells score	23 14	6 24	62.16	80.0	42.16	70.15	41.12
Revised Geneva score	24 13	2 28	64.87	93.33	58.20	77.61	50.41
Pisa score	30	1	81.08	96.67	77.75	88.06	76.30

ment of clinical probability, which is also a main basis for further examinations. When the confirmatory examinations including CTPA, V/Q scanning, and contrast-enhanced examinations may not be conducted under certain conditions, the full usage of the currently available (and often limited) clinical information becomes particularly important. Clinical scoring is relatively easy to perform, and can often be completed at the bedside. While three scoring systems described in current study have been increasingly applied in clinical settings, these have different criteria and may result in different groupings of the clinical probabilities. According to Calisir et al[4], the Wells score may be more accurate compared to the revised Geneva score. While, the Wells score is more suitable for inpatients and emergency patients, the revised Geneva score can be applied for emergency patients who are highly suspected to be inflicted with PTE. As shown in our study, both of these scores had good predictive values for PTE; the incidence of PTE increases along with an increased probability. Wells scoring is simple but contains a high-scored subjective judgment, i.e. whether a diagnosis of PTE is more probable than other disorders. This score is hard to be standardized and rated with a high score (up to 3); for physicians with less clinical experience, and thus makes appropriate evaluation of the probabilities challenging. On the contrary, the revised Geneva score and Pisa score are easier to rate and most items in these two systems are objective indicators such as risk factors including fractures, ageing, unilateral lower limb pain, and hemoptysis, thus reducing the impact of unstable factors on the final conclusions. Consequently, the combined application of these three scoring systems may increase the early detection rate of PTE, particularly in emergency rooms or community hospitals or for patients who can not be moved for special examinations. The combined Wells score, revised Geneva score, and Pisa score, together with the results of a D-dimer test, can efficiently rule out patients with low-probability of PTE. While CTPA or CT venography (CTV) will markedly lower the misdiagnosis rate of PTE for patients with moderate- or high-probability[5].

Conclusions

Our study analyzed the role of three scoring systems to evaluate the clinical probability of PTE among in patients in Xining area. Comparisons of the AUCs, showed that the Pisa score has relatively higher predictability value for the probability of PTE in Xining area and its overall sensitivity and specificity are superior than the Wells score and the revised Geneva score, which is consistent with the findings of Miniati et al[5]. However, our study has a small sample size. Studies with larger sample size are warranted to further validate our findings.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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