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Usefulness of combined white blood cell count and blood glucose for predicting in-hospital outcomes in acute ischemic stroke

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Background and aims

High white blood cell (WBC) count and blood glucose are the risk factors for mortality and pneumonia after acute ischemic stroke (AIS). We investigated the association between combination effect of WBC count and blood glucose upon hospital admission and in-hospital mortality and pneumonia in acute AIS patients.

Methods

A total of 3,124 AIS patients enrolled from December 2013 to May 2014 across 22 hospitals in Suzhou city were included in the present study. We divided patients into 4 groups according to their level of WBC count and blood glucose level: NWNG (normal WBC count and normal glucose), NWHG (normal WBC count and higher glucose), HWNG (higher WBC count and normal glucose) and HWHG (higher WBC count and higher glucose). Cox proportional hazard and logistic model was used to estimate the effect of combination effect of WBC count and blood glucose on all cause in-hospital mortality and pneumonia in AIS patients.

Results

Patients with HWHG were associated with a 2.89-fold increase in the risk of in-hospital mortality in comparison to NWNG (adjusted hazard ratio [HR] 2.89; 95% confidence interval [CI], 1.59–5.23; P -trend <0.001) after adjusting for potential covariates. The risk of pneumonia is significant higher in patients with HWHG comparison to those with NWNG (adjusted odds ratio [OR] 2.62; 95% CI, 1.67–4.10; P -trend <0.001). The C-statistic of the combination of WBC count and blood glucose were significantly larger than WBC count or blood glucose alone for in-hospital mortality and pneumonia(all P <0.001)

Fig.1 Cumulative incidence curves of in-hospital mortality by WBC count and blood glucose level

Conclusions

High WBC count with high blood glucose levels at admission was independently associated with in-hospital mortality and pneumonia in AIS patients. Moreover, the combination of WBC count and blood glucose appeared to be a better predictor than WBC count or blood glucose alone.

Table 2. Hazard ratios and 95% confidence intervals of in-hospital mortality according to level of serum white blood cell and blood glucose					
Four groups according to white blood cell and blood glucose					
	NWNG	NWHG	HWNG	HWHG	P-trend
No.	2025	681	266	152	
No. of deaths	35(1.7)	26(3.8)	19(7.1)	24(15.8)	
Crude	1.00	2.02 (1.21–3.56)	3.89 (2.21–6.77)	7.59 (4.47–12.88)	<0.001
Model 1	1.00	2.12 (1.27–3.54)	3.95 (2.26–6.91)	7.68 (4.53–13.01)	<0.001
Model 2	1.00	1.39 (0.79–2.46)	2.30 (1.27–4.14)	2.89 (1.59–5.23)	<0.001
Sensitivity analysis					
Model 3	1.00	1.19 (0.63–2.28)	2.05 (1.07–3.93)	2.55 (1.27–5.13)	0.002
Model 4	1.00	1.24 (0.68–2.25)	2.23 (1.23–4.05)	2.44 (1.30–4.57)	0.001
Model 1, adjusted for age and sex;					
Model 2, adjusted for age, sex, systolic BP, body temperature, time from onset to admission, cigarette smoking status, alcohol drinking, history of hypertension, history of diabetes mellitus, history of coronary heart disease, history of atrial fibrillation, history of stroke, thrombolysis treatment, baseline National Institutes of Health Stroke Scale score, eGFR levels, and pneumonia.					
Model 3, adjusted for model 2 and further restricted to patients with first-ever stroke.					
Model 4, adjusted for model 2 and further restricted to patients with time from onset to admission ≤48 hours.					

Table 3. Odds ratios and 95% confidence intervals of pneumonia according to level of serum white blood cell and blood glucose					
Four groups according to white blood cell and blood glucose					
	NWNG	NWHG	HWNG	HWHG	P-trend
No.	2025	681	266	152	
No. of deaths	265(13.1)	125(18.4)	85(32.0)	60(39.5)	
Crude	1.00	1.49 (1.18–1.89)	3.12 (2.34–4.16)	4.33 (3.05–6.15)	<0.001
Model 1	1.00	1.59 (1.25–2.02)	3.67 (2.70–5.00)	5.26 (3.61–7.66)	<0.001
Model 2	1.00	1.34 (0.98–1.82)	2.06 (1.45–2.93)	2.62 (1.67–4.10)	<0.001
Sensitivity analysis					
Model 3	1.00	1.13 (0.78–1.62)	2.17 (1.47–3.21)	2.43 (1.44–4.10)	<0.001
Model 4	1.00	1.25 (0.89–1.77)	1.88 (1.28–2.77)	2.72 (1.68–4.41)	<0.001
Model 1, adjusted for age and sex;					
Model 2, adjusted for age, sex, systolic BP, body temperature, time from onset to admission, cigarette smoking status, alcohol drinking, history of hypertension, history of diabetes mellitus, history of coronary heart disease, history of atrial fibrillation, history of stroke, thrombolysis treatment, baseline National Institutes of Health Stroke Scale score, eGFR levels.					
Model 3, adjusted for model 2 and further restricted to patients with first-ever stroke.					
Model 4, adjusted for model 2 and further restricted to patients with time from onset to admission ≤48 hours.

Fig.2 Association between co-existing higher WBC count and higher blood glucose on in-hospital mortality and pneumonia in AIS patients

Fig.3 ROC curve of combined WBC count and blood glucose level on in-hospital mortality and pneumonia