·临床研究·

营养风险与老年重症肺炎患者预后的相关性

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【摘 要】 **目的** 分析老年重症肺炎患者机体营养风险与其预后的相关性,研究老年营养风险指数(GNRI)在老年重症肺炎中的应用价值。**方法** 将佛山复星禅诚医院2020年1月至2022年1月收治的133例老年重症肺炎患者纳为研究对象,入院后24 h内采用GNRI调查营养风险,将高危营养风险者纳为高危组,其余患者作为其余分级组。高危营养风险者均进行营养支持治疗,按照营养支持干预时机分为早期、中期及晚期,比较不同营养支持干预时机者预后情况;统计患者28 d死亡率,根据患者生存情况分为死亡组及存活组。采用SPSS 19.0软件进行数据分析。根据数据类型,组间比较分别采用t检验及χ^2检验。采用二元logistic回归模型分析影响老年重症肺炎患者预后(28 d内死亡)的相关因素,绘制受试者工作特征(ROC)曲线,分析GNRI在预测老年重症肺炎患者28 d内死亡中的价值。**结果** 133例老年重症肺炎患者中,高危营养风险者共28例(21.05%),对比发现,GNRI高危分级组年龄、革兰阴性菌检出率、机械通气、休克发生率高于其他分级组,体质量指数、血清白蛋白以及前白蛋白水平低于其他分级组,差异均有统计学意义(P<0.05);高危营养风险者均行营养支持治疗,其中早期、中期及晚期进行营养干预者机械通气时间、血管活性药物使用时间、住院时间均呈依次升高趋势,且早期干预者死亡率低于晚期干预者,差异均有统计学意义(P<0.05);133例老年重症肺炎患者中,28 d内死亡者35例(26.32%)。二元logistic回归模型分析证实,入院时急性生理与慢性健康评分Ⅱ(APACHEⅡ)评分(OR=1.906,95%CI 1.350~2.691)、多器官功能障碍综合征(MODS)评分(OR=2.079,95%CI 1.254~3.448)、机械通气(OR=2.177,95%CI 1.313~3.610)以及高危GNRI分级(OR=2.575,95%CI 1.778~3.730)是老年重症肺炎患者28 d内死亡的危险因素(均P<0.05);绘制ROC曲线发现,GNRI在预测老年重症肺炎患者28 d死亡中价值(AUC=0.706, 95%CI 0.607~0.806)明显高于APACHEⅡ评分(AUC=0.534,95%CI 0.428~0.641)、MODS评分(AUC=0.564,95%CI 0.460~0.668)以及机械通气(AUC=0.628,95%CI 0.518~0.737)等其他危险因素(均P<0.05)。**结论** 建议临床在老年重症肺炎患者入院后尽早利用GNRI进行营养风险筛查,并及时对存在高风险营养不良者尽早进行营养干预,进而改善患者预后。

【关键词】 老年人;重症肺炎;老年营养风险指数;预后
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Correlation of nutritional risk and prognosis in elderly patients with severe pneumonia

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【**Abstract**】 **Objective** To analyze the correlation between body nutritional risk and prognosis in elderly patients with severe pneumonia, and to study the application value of geriatric nutritional risk index (GNRI) for elderly patients with severe pneumonia. **Methods** A total of 133 elderly patients with severe pneumonia admitted to Foshan Fosun Chancheng Hospital from January 2020 to January 2022 were recruited, and according to their GNRI within 24 h after admission, the patients with high nutritional risk were assigned into high-risk group, and the other patients were into other classification groups. The patients with high nutritional risk were given nutritional support treatment, and based on the intervention timing of nutritional support, they were divided into early-, middle- and late-stage subgroups. The prognosis was compared among the patients of different timing of nutritional support. After the 28-day mortality rate was counted, the patients were grouped into death and survival groups. SPSS statistics 19.0 was used to process the data. Data comparison between two groups was perfomed using t test or χ^2 test depending on data type. Binary logistic regression model was applied to analyze the related factors affecting the prognosis (death within 28 d) in elderly patients with severe pneumonia, and receiver operating characteristic (ROC) curve was drawn to analyze the value of GNRI in predicting the 28-day mortality in these elderly patients. **Results** Among the 133 elderly patients with severe pneumonia, there were 28 cases (21.05%) with high nutritional risk. The patients with high nutritional risk had advanced age, higher detection rate of Gram-negative bacteria, larger ratio of mechanical ventilation and higher incidence of

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shock, but lower body mass index, serum albumin and pre-albumin levels when compared with the other classification groups ($P<0.05$). After the patients with high nutritional risk were treated with nutritional support, the times for mechanical ventilation and vasoactive drug use and length of hospital stay were all in increasing trends in the patients with early, middle and late nutritional interventions in turn, and the death rate was lower in the patients with early intervention than those with late intervention ($P<0.05$). Among the 133 elderly patients with severe pneumonia, 35 cases (26.32%) eventually died within 28 d after admission. Binary logistic regression analysis confirmed that Acute Physiology and Chronic Health Evaluation Ⅱ (APACHE Ⅱ) score at admission ($OR=1.906$, 95%CI 1.350-2.691), multiple organ dysfunction syndrome (MODS) score ($OR=2.079$, 95%CI 1.254-3.448), mechanical ventilation ($OR=2.177$, 95%CI 1.313-3.610) and high-risk GNRI grade ($OR=2.575$, 95%CI 1.778-3.730) were risk factors for 28-day death in elderly patients with severe pneumonia. ROC curve analysis found that the AUC value of GNRI ($AUC=0.706$, 95%CI 0.607-0.806) in predicting 28-day death in elderly patients with severe pneumonia was significantly higher ($P<0.05$) than that of APACHE Ⅱ score ($AUC=0.534$, 95%CI 0.428-0.641), MODS score ($AUC=0.564$, 95%CI 0.460-0.668) and mechanical ventilation ($AUC=0.628$, 95%CI 0.518-0.737). **Conclusion** It is suggested that GNRI should be used for nutritional risk screening in elderly patients with severe pneumonia as soon as possible after admission, and nutritional intervention should be carried out in time for those with high-risk malnutrition so as to improve the prognosis of patients.

【Key words】 aged; severe pneumonia; geriatric nutritional risk index; prognosis

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营养状态对多种疾病预后均有影响[1,2]。老年人多存在多病共存、食欲下降、胃肠道菌群失衡、免疫力下降等表现,营养不良风险高,而重症肺炎本身会增加机体耗能,进一步增加营养风险,故有效评估老年重症肺炎患者营养风险在临床中具有一定意义。目前,由于种种原因,营养风险筛查在临床中并不普遍。老年营养风险指数(geriatric nutritional risk index, GNRI)是一种专用于评估老年疾病患者机体营养状况的指标,具有操作方便简易、价格低廉等优势[3]。本研究旨在探讨 GNRI 用于老年重症肺炎营养风险筛查中的效果及其与患者预后的相关性,现报道如下。

1 对象与方法

1.1 研究对象

将 2020 年 1 月至 2022 年 1 月佛山复星禅诚医院收治的 133 例老年重症肺炎患者纳为研究对象。

纳入标准:年龄≥65 岁;符合美国感染病学会/美国胸科学会提出的重症肺炎相关诊断标准[4];临床资料完整。排除标准:入院 48 h 内死亡;既往器官移植史;合并血液病、艾滋病等严重免疫抑制性疾病。

1.2 方法

1.2.1 营养风险筛查及分组 所有患者均在入院后 24 h 内采用 GNRI 评估其机体营养风险。根据 Bouillanne 等[5]的研究结果,将 GNRI<82 定义为高危,82≤GNRI<92 定义为中危,92≤GNRI<98 定义为低危,GNRI≥98 定义为正常。将高危营养风险者纳为高危组,其余营养风险者纳为其余分级组。

1.2.2 营养支持治疗及治疗指标统计 本研究中,老年重症肺炎高危营养风险者均进行营养支持治疗,根据其营养支持治疗时机将其分为早期(入院 12 h 内)、中期(入院 12~24 h)及晚期(入院 24 h 后),收集并比较不同营养支持治疗时机对高危营养风险者机械通气、休克、机械通气时间、住院时间及血管活性药物使用时间等治疗指标的影响。

1.2.3 预后统计及分组 随访 28 d,统计老年重症肺炎患者 28 d 死亡率,根据患者 28 d 存活情况将其分为存活组及死亡组。

1.2.4 临床及实验室参数收集 通过查阅患者病历资料,收集患者性别、年龄、体质量指数(body mass index, BMI),入院时急性生理与慢性健康评分Ⅱ(acute physiology and chronic health evaluationⅡ, APACHEⅡ)、多器官功能障碍综合征(multiple organ dysfunction syndrome, MODS)、病原微生物检测结果及入院时实验室检查等指标。

1.3 统计学处理

采用 SPSS 19.0 统计软件进行数据分析。符合正态分布的计量资料用均数±标准差($\bar{x}\pm s$)表示,两组间比较采用 t 检验;多组间比较采用单因素方差分析,两两比较行 LSD-t 检验。计数资料用例数(百分率)表示,组间采用 χ^2 检验,等级资料采用行秩和检验。采用二元 logistic 回归模型分析影响老年重症肺炎患者预后(28 d 内死亡)的相关因素,绘制受试者工作特征(receiver operating characteristic, ROC)曲线,评价 GNRI 在预测老年重症肺炎患者预后(28 d 内死亡)中的效能。$P<0.05$ 为差异有统计学意义。

2 结 果

2.1 老年重症肺炎营养风险筛查结果及不同营养风险者相关资料比较

统计发现,133 例老年重症肺炎患者中高危营养风险者共 28 例(21.05%)、中危者共 33 例(24.81%)、

低危者共34例(25.57%)、正常者共38例(28.57%)。对比发现,GNRI高危分级患者年龄、革兰阴性菌检出率、机械通气、休克发生率高于其他分级组,BMI、血清白蛋白以及前白蛋白水平低于其他分级组,差异均有统计学意义(P<0.05),其余指标比较,差异无统计学意义(表1)。

2.2 营养支持时机对高危营养风险者治疗相关指标的影响

早期、中期及晚期进行营养干预的高危营养风险者机械通气时间、血管活性药物使用时间、住院时间均呈依次升高趋势,且早期干预者死亡率低于晚期干预者,差异均有统计学意义(均 P<0.05;表2)。

2.3 老年重症肺炎预后统计及不同预后患者临床资料比较

随访28 d统计发现,133例老年重症肺炎患者中,28 d内死亡患者35例(26.32%),将其纳为死亡组,存活患者98例(73.68%),将其纳为存活组。分析发现,死亡组患者氧合指数低于存活组、入院时APACHEⅡ评分、MODS评分以及机械通气占比高于存活组,GNRI分级整体高于存活组,差异均有统计学意义(均 P<0.05)。其余指标比较,差异无统计学意义(表3)。

2.4 二元 logistic 回归模型分析影响老年重症肺炎患者预后的相关因素

以老年重症肺炎患者28 d预后情况作为因变量(Y,0=存活,1=死亡),将表3中分析有意义的指标作为自变量纳入二元logistic回归模型,分析结果显示,入院时APACHEⅡ评分、MODS评分、机械通气以及高危GNRI分级是老年重症肺炎患者28 d死亡的危险因素(P<0.05;表4)。

2.5 各指标预测老年重症肺炎患者预后中的价值

绘制ROC曲线发现,GNRI<87分时,在预测老年重症肺炎患者28 d死亡中的价值明显高于APACHEⅡ评分、MODS评分以及机械通气(P<0.05;表5,图1)。

表1 不同营养风险者临床资料及治疗相关指标比较

Table 1 Comparison of clinical data and treatment-related indicators among patients with different nutritional risks

Item	High-risk group(n=28)	Other classification group(n=105)	t/χ^2	P value
Gender[n(%)]			0.010	0.920
Male	20(71.43)	76(72.38)		
Female	8(28.57)	29(27.62)		
Age[n(%)]			5.406	0.020
65-80 years	6(21.43)	48(45.71)		
≥80 years	22(78.57)	57(54.29)		
BMI(kg/m^2, $\bar{x}\pm s$)	20.55±1.96	23.51±2.13	6.639	<0.001
APACHEⅡ(points, $\bar{x}\pm s$)	18.65±2.37	18.01±2.25	1.323	0.188
MODS(points, $\bar{x}\pm s$)	7.73±1.05	7.92±1.17	0.779	0.437
White blood cell count($\times10^9$/L, $\bar{x}\pm s$)	10.15±1.63	9.89±1.58	0.769	0.444
Platelet($\times10^9$/L, $\bar{x}\pm s$)	193.54±16.35	189.43±17.17	1.136	0.258
Hemoglobin(g/dl, $\bar{x}\pm s$)	101.74±15.58	102.41±14.57	0.213	0.832
Lymphocyte count($\times10^9$/L, $\bar{x}\pm s$)	0.73±0.12	0.69±0.14	1.382	0.169
Monocyte count($\times10^9$/L, $\bar{x}\pm s$)	0.52±0.09	0.51±0.11	0.443	0.659
Serum creatinine($\bar{x}\pm s$, μmol/L)	88.47±13.25	87.17±16.74	0.380	0.705
BUN($\bar{x}\pm s$, mmol/L)	9.87±2.22	10.11±2.14	0.523	0.602
Albumin(g/dl, $\bar{x}\pm s$)	26.15±3.85	34.17±3.37	10.853	<0.001
Prealbumin(g/dl, $\bar{x}\pm s$)	0.13±0.03	0.18±0.02	10.481	<0.001
Pathogenic microbial infection[n(%)]				
Gram-negative bacterial infection	16(57.14)	13(12.38)	25.977	<0.001
Gram-positive bacterial infection	13(46.43)	32(30.48)	2.513	0.113
Mixed infection	3(10.71)	5(4.76)	1.385	0.239
Mechanical ventilation[n(%)]	20(71.43)	31(29.52)	16.419	<0.001
Shock[n(%)]	18(64.29)	35(33.33)	8.835	0.003

BMI: body mass index; APACHEⅡ: acute physiology and chronic health evaluationⅡ; MODS: multiple organ dysfunction syndrome; BUN: urine nitrogen.

表2 早期营养支持对高危营养风险者治疗相关指标的影响

Table 2 Influence of early nutritional support on treatment-related indicators in patients with high nutritional risk

Timing of nutritional support	n	Mechanical ventilation time (d, $\bar{x}\pm s$)	Vasoactive drug use time (h, $\bar{x}\pm s$)	Hospital stay(d, $\bar{x}\pm s$)	Death[n(%)]
Early stage	12	4.03±0.89	23.11±4.25	16.58±2.69	3(25.00)
Middle stage	8	4.85±0.79*	27.82±6.39*	19.11±2.97*	5(62.50)
Late stage	8	6.38±1.33$^{*\#}$	37.58±7.43$^{*\#}$	24.71±3.11$^{*\#}$	8(100.00)*
F		12.181	13.020	18.348	11.156
P value		<0.001	<0.001	<0.001	0.004

Compared with early stage, $^*P$<0.05; compared with middle stage, $^\#P$<0.05.

表 3 老年重症肺炎预后统计及不同预后患者临床资料比较

Table 3 Prognosis statistics of elderly patients with severe pneumonia and comparison of clinical data of patients with different prognosis status

Factor	Death group(n=35)	Survival group(n=98)	t/χ^2/Z	P value
Gender[n(%)]			0.013	0.908
Male	25(71.43)	71(72.45)		
Female	10(28.57)	27(27.55)		
Age[n(%)]			0.236	0.627
65-79 years	13(37.14)	41(41.84)		
≥80 years	22(62.86)	57(58.16)		
Oxygenation index($\bar{x}\pm s$)	246.58±53.15	311.74±49.87	6.521	<0.001
SBP(mmHg, $\bar{x}\pm s$)	126.25±6.55	125.15±7.02	0.809	0.420
APACHE Ⅱ(points, $\bar{x}\pm s$)	23.15±2.15	16.38±2.57	13.931	<0.001
MODS(points, $\bar{x}\pm s$)	10.63±1.79	6.84±1.39	12.797	<0.001
WBC($\times10^9$/L, $\bar{x}\pm s$)	10.35±1.85	9.97±1.93	1.011	0.314
Platelet($\times10^9$/L, $\bar{x}\pm s$)	187.58±25.17	191.15±22.98	0.769	0.443
Hemoglobin(g/dl, $\bar{x}\pm s$)	98.89±12.57	103.22±13.11	1.695	0.092
Lymphocyte count($\times10^9$/L, $\bar{x}\pm s$)	0.69±0.15	0.71±0.17	0.615	0.539
Monocyte count($\times10^9$/L, $\bar{x}\pm s$)	0.49±0.08	0.51±0.09	1.161	0.248
Serum creatinine(μmol/L, $\bar{x}\pm s$)	86.58±10.57	88.07±11.36	0.678	0.499
Blood urea nitrogen(mmol/L, $\bar{x}\pm s$)	10.36±1.27	9.98±1.33	1.468	0.145
Albumin(g/L, $\bar{x}\pm s$)	33.27±3.47	32.77±3.36	0.749	0.455
Prealbumin(g/L, $\bar{x}\pm s$)	0.17±0.03	0.16±0.04	1.348	0.180
Mechanical ventilation[n(%)]	20(57.14)	31(31.63)	7.099	0.008
Pathogenic microbial infection[n(%)]			2.666	0.264
Gram-negative bacterial infection	17(18.57)	22(22.45)		
Gram-positive bacterial infection	12(32.29)	33(33.67)		
Mixed infection	3(8.57)	5(5.10)		
GNRI[n(%)]			27.080	<0.001
High-risk	16(45.71)	12(12.24)		
Moderate-risk	13(37.14)	20(20.41)		
Low-risk	4(11.43)	30(30.61)		
Normal	2(5.71)	36(36.73)		

SBP: systolic blood pressure; APACHE Ⅱ: acute physiology and chronic health evaluation Ⅱ; MODS: multiple organ dysfunction syndrome; WBC: white blood cell; GNRI: geriatric nutritional risk index. 1 mmHg=0.133 kPa.

表 4 二元 logistic 回归模型分析影响老年重症肺炎患者预后的相关因素

Table 4 Binary logistic regression model analysis of related factors affecting prognosis of elderly patients with severe pneumonia

Influencing factor	β	SE	$Wald\ \chi^2$	OR	P value	95CI
Oxygenation index	−0.663	0.487	1.853	0.515	0.174	0.198-1.338
APACHE Ⅱ score	0.645	0.176	13.431	1.906	<0.001	1.350-2.691
MODS score	0.732	0.258	8.050	2.079	0.005	1.254-3.448
Mechanical ventilation	0.778	0.258	9.093	2.177	0.003	1.313-3.610
GNRI high-risk grade	0.946	0.189	25.053	2.575	<0.001	1.778-3.730

APACHE Ⅱ: acute physiology and chronic health evaluation Ⅱ; MODS: multiple organ dysfunction syndrome; GNRI: geriatric nutritional risk index.

表 5 各指标在预测老年重症肺炎患者预后中的价值

Table 5 Value of each indicator on predicting prognosis in elderly patients with severe pneumonia

Indicator	AUC	95%CI	P value	Sensitivity	Specificity
GNRI<87 points	0.706	0.607-0.806	<0.001	0.571	0.786
APACHE Ⅱ>17 points	0.534*	0.428-0.641	0.547	0.657	0.429
MODS>7 points	0.564*	0.460-0.668	0.261	0.914	0.235
Mechanical ventilation	0.628*	0.518-0.737	0.025	0.571	0.684

GNRI: geriatric nutritional risk index; APACHE Ⅱ: acute physiology and chronic health evaluation Ⅱ; MODS: multiple organ dysfunction syndrome; AUC: area under the curve. Compared with AUC of GNRI, *P<0.05.

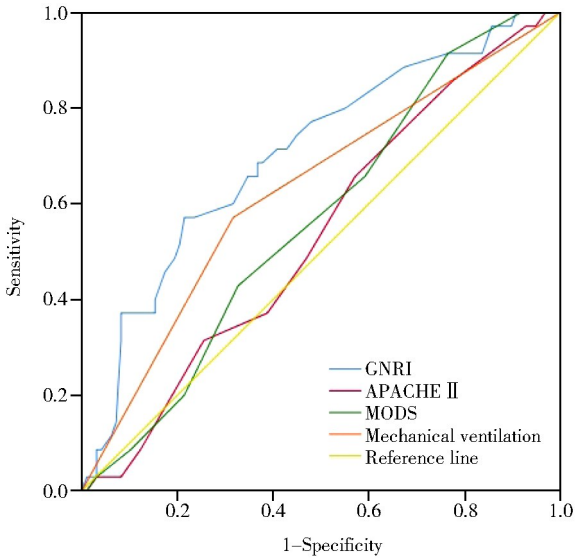

图1 各指标预测老年重症肺炎患者预后中的ROC曲线

Figure 1 ROC curves of various indicators on predicting prognosis of elderly patients with severe pneumonia

ROC: receiver operating characteristic; GNRI: geriatric nutritional risk index; APACHE Ⅱ: acute physiology and chronic health evaluation Ⅱ; MODS: multiple organ dysfunction syndrome.

3 讨 论

GNRI是一种复合型营养风险筛查工具,较血清白蛋白、总蛋白等单一指标能更好地反映营养状况[6,7],较2002营养风险筛查、微型营养评价法等常用评估量表而言,又具有操作方便简易的优势[8,9]。本研究发现,老年重症肺炎患者GNRI高、中及低危风险者分别占比21.05%、24.81%、25.57%,说明老年重症肺炎患者普遍存在不同程度的营养风险。进一步研究发现,存在高危营养不良风险者普遍具有高龄、低BMI、低血清白蛋白(albumin, ALB)及低前白蛋白水平等特征[10,11]。提示高龄、低BMI患者高危营养不良风险更高,且积极检测患者入院时血清ALB及前白蛋白水平在帮助临床快速识别高危营养风险者中也具有一定意义。此外,本研究发现,GNRI高危分级患者革兰阴性菌检出率高于其他分级组患者,这可能与革兰阴性菌侵袭性更强,所造成的营养消耗更大,增加营养不良风险相关[12]。

本研究分析发现,GNRI高危分级者机械通气、休克发生率高于其他分级组,说明营养风险高会恶化病情,与曹园园等[13]研究结论相似。但本研究同时发现,早期营养支持干预能有效缩短老年重症肺炎高危营养风险者机械通气、血管活性药物使用以及住院时间,并降低死亡率。说明尽早进行营养风险筛查与营养干预,在改善患者预后中具有重要意义。田佳[14]也证实早期营养支持能有效改善老年重症肺炎者机体免疫力,提高患者预后。

此外,随访发现,133例老年重症肺炎患者中死亡患者共35例(26.32%),经logistic回归分析发现,GNRI高危分级与患者入院时APACHE Ⅱ评分、MODS评分、机械通气一同被证实为影响患者预后的危险因素。绘制ROC曲线发现,入院时GNRI评分在预测老年重症肺炎患者28 d死亡中的价值高于其他危险因素,说明利用GNRI评分筛查营养不良风险,并尽早进行营养支持干预,在改善老年重症肺炎患者预后中具有重要意义。

综上,建议临床尽早应用GNRI对老年重症肺炎患者进行营养风险筛查,对存在高风险营养不良者尽早进行营养干预,进而改善患者预后。

【参考文献】

[1] Asakawa A, Ishibashi H, Matsuyama Y, *et al*. Preoperative nutritional status is associated with the prognosis for lung cancer[J]. Asian Cardiovasc Thorac Ann, 2021, 29(8): 763-771. DOI: 10.1177/02184923211014002.

[2] 肖雨, 高时娟, 彭顺仙, 等. 老年结直肠癌患者化疗期间营养不良的危险因素及其预测模型构建[J]. 中华老年多器官疾病杂志, 2024, 23(6): 407-410. DOI: 10.11915/j.issn.1671-5403.2024.06.089.

[3] Dai C, Yan D, Xu M, *et al*. Geriatric nutritional risk index is related to the risk of stroke-associated pneumonia[J]. Brain Behav, 2022, 12(8): e2718. DOI: 10.1002/brb3.2718.

[4] Liapikou A, Ferrer M, Polverino E, *et al*. Severe community-acquired pneumonia: validation of the Infectious Diseases Society of America/American Thoracic Society guidelines to predict an intensive care unit admission[J]. Clin Infect Dis, 2009, 48(4): 377-385. DOI: 10.1086/596307.

[5] Bouillanne O, Morineau G, Dupont C, *et al*. Geriatric nutritional risk index: a new index for evaluating at-risk elderly medical patients[J]. Am J Clin Nutr, 2005, 82(4): 777-783. DOI: 10.1093/ajcn/82.4.777.

[6] Chen Y, Xiang Q, Li C, *et al*. Nutritional risk and assessment for patients with cancer pain[J]. Nutr Cancer, 2022, 74(1): 168-174. DOI: 10.1080/01635581.2021.1882510.

[7] Zhang P, Wang Q, Zhu M, *et al*. Differences in nutritional risk assessment between NRS2002, RFH-NPT and LDUST in cirrhotic patients[J]. Sci Rep, 2023, 13(1): 3306. DOI: 10.1038/s41598-023-30031-1.

[8] Ueshima J, Momosaki R, Shimizu A, *et al*. Nutritional assessment in adult patients with dysphagia: a scoping review[J]. Nutrients, 2021, 13(3): 778. DOI: 10.3390/nu13030778.

[9] Gulsoy KY, Orhan S. The relationship between mortality and the modified nutrition risk in critically ill (mNUTRIC) and nutritional risk screening 2002 (NRS-2002) scores in the intensive care unit[J]. J Coll Physicians Surg Pak, 2022, 32(7): 848-854. DOI: 10.29271/jcpsp.2022.07.848.

[10] Güç ZG, Alacacıoğlu A, Kalender ME, *et al*. HALP score and GNRI: simple and easily accessible indexes for predicting prognosis in advanced stage NSCLC patients. The İzmir oncology group (IZOG) study[J]. Front Nutr, 2022, 9: 905292. DOI: 10.3389/fnut.2022.905292.

[11] Liu L, Chen Y, Xie J. Association of GNRI, NLR, and FT3 with the clinical prognosis of older patients with heart failure[J]. Int Heart J, 2022, 63(6): 1048-1054. DOI: 10.1536/ihj.22-306.

[12] Woerther PL, Angebault C, Jacquier H, *et al*. Massive increase, spread, and exchange of extended spectrum β-lactamase-encoding genes among intestinal *Enterobacteriaceae* in hospitalized children with severe acute malnutrition in Niger[J]. Clin Infect Dis, 2011,53(7): 677-685. DOI: 10.1093/cid/cir522.

[13] 曹园园, 赵丽, 缪红军. 急诊肺炎患儿进展为重症肺炎的危险因素分析[J]. 中华危重病急救医学, 2023, 35(5): 528-532. DOI: 10.3760/cma.j.cn121430-20220315-00248.

[14] 田佳. 早期营养支持联合谷氨酰胺和低分子肝素对老年重症肺炎患者的疗效研究[J]. 重庆医学, 2016, 45(19): 2648-2651. DOI: 10.3969/j.issn.1671-8348.2016.19.018.

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