·临床研究·

老年营养风险指数联合血尿酸对老年急性呼吸窘迫综合征患者预后的预测价值

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【摘 要】 **目的** 探讨老年营养风险指数(GNRI)联合血尿酸(SUA)对老年急性呼吸窘迫综合征(ARDS)患者预后的预测价值。**方法** 回顾性分析2018年1月至2021年9月中国人民解放军西部战区总医院收治的159例老年ARDS患者的临床资料。根据28 d预后情况分为生存组(n=116)和死亡组(n=43);根据氧合指数分为ARDS轻度组(n=35)、中度组(n=70)和重度组(n=54)。收集患者临床资料,计算GNRI值,检测SUA水平。采用SPSS 22.0软件对数据进行统计分析。采用受试者工作特征(ROC)曲线和Kaplan-Merier曲线分析GNRI和SUA对老年ARDS患者预后的评估价值。**结果** 生存组和死亡组患者急性生理学和慢性健康状况评分Ⅱ、序贯性器官衰竭评分、氧合指数和病情严重程度比较,差异均有统计学意义(均P<0.05)。与生存组相比,死亡组患者GNRI水平显著降低[(77.42±7.06)和(88.17±10.39)分],SUA水平显著升高[(544.46±63.97)和(469.70±45.69)μmol/L],差异均有统计学意义(均P<0.05)。ARDS重度组患者GNRI水平显著低于轻度组和中度组[(81.37±10.14)和(90.17±10.69),(85.81±10.15)分;均P<0.05],SUA水平显著高于轻度组和中度组[(514.05±61.52)和(458.84±58.10),(486.84±54.64)μmol/L;均P<0.05]。Pearson相关性分析显示,氧合指数与GNRI呈正相关(r=0.412,P<0.01),与SUA呈负相关(r=-0.403,P<0.01)。ROC曲线分析显示,GNRI联合SUA预测老年ARDS患者预后的曲线下面积为0.892、灵敏度为83.72%、特异度为81.90%,优于单一指标检测。Kaplan-Merier曲线分析显示,与GNRI≥83.07分患者相比,GNRI<83.07分患者28 d死亡率显著增加;与SUA≤493.13 μmol/L患者相比,SUA>493.13 μmol/L患者28 d死亡率显著增加,差异均有统计学意义(均P<0.05)。**结论** GNRI和SUA与老年ARDS患者的疾病严重程度和预后密切相关,二者联合检测对ARDS患者预后的预测价值更高。

【关键词】 呼吸窘迫综合征;营养风险指数;血尿酸;病情严重程度;预后
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Predictive value of geriatric nutritional risk index combined with serum uric acid in prognosis of elderly patients with acute respiratory distress syndrome

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【**Abstract**】 **Objective** To investigate the predictive value of geriatric nutritional risk index (GNRI) combined with serum uric acid (SUA) for the prognosis of elderly patients with acute respiratory distress syndrome (ARDS). **Methods** The clinical data of 159 ARDS patients admitted to our hospital between January 2018 and September 2021 were collected and retrospectively analyzed. According to their 28-day outcomes, they were divided into survival (n=116) and death (n=43) groups. Based on their oxygenation index, they were assigned into mild (n=35), moderate (n=70) and severe (n=54) groups. Clinical data of the patients were collected, GNRI values were calculated, and SUA levels were detected. The data were analyzed by SPSS statistics 22.0. Receiver operating characteristic (ROC) curve and Kaplan-Merier curves were used to analyze the prognostic values of GNRI and SUA for elderly patients with ARDS. **Results** The survival and death patients differed in oxygenation index, severity of illness, and scores of Acute Physiology and Chronic Health Evaluation Ⅱ and Sequential Organ Failure Assessment (all P<0.05). The deceased patients had significantly lower GNRI level [(77.42±7.06) *vs* (88.17±10.39) points] and higher SUA level [(544.46±63.97) *vs* (469.70±45.69) μmol/L] than the survival group (both P<0.05). The severe ARDS patients had significantly lower GNRI level [(81.37±10.14) *vs* (90.17±10.69) and (85.81±10.15) points; both P<0.05] and higher SUA level [(514.05±61.52) *vs* (458.84±58.10) and (486.84±54.64) μmol/L; both P<0.05], when compared with the mild and moderate patients. Pearson correlation analysis revealed that oxygenation index was positively

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correlated with GNRI (r=0.412, P<0.01) and negatively with SUA (r=−0.403, P<0.01). ROC curve analysis showed that GNRI combined with SUA had an area under curve of 0.892, a sensitivity of 83.72% and a specificity of 81.90% for predicting the outcome of ARDS patients, which was superior to single index test. Kaplan-Meier curve analysis indicated that the 28-day mortality rate in the patients of GNRI≥83.07 points and SUA≤493.13 μmol/L, respectively, was lower in those with GNRI<83.07 points and with SUA>493.13 μmol/L (P<0.05). **Conclusion** GNRI and SUA are closely associated with disease severity and prognosis in elderly patients with ARDS, and the 2 indicators combined together have greater predictive value for the prognosis of elderly patients with ARDS.

【Key words】 respiratory distress syndrome; nutritional risk index; blood uric acid; severity of illness; prognosis

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急性呼吸窘迫综合征(acute respiratory distress syndrome,ARDS)是一种常见的危重病,以低氧血症和严重呼吸窘迫为特征,可导致多器官功能障碍综合征甚至死亡[1]。随着医疗技术的发展,ARDS诊治取得了一定成效,但病死率仍高达30%~40%,严重危害患者生命健康[2]。目前,临床上应用急性生理学和慢性健康状况评分Ⅱ(acute physiology and chronic health evaluation Ⅱ,APACHE Ⅱ)和序贯性器官衰竭评估(sequential organ failure assessment,SOFA)评分等指标预测ARDS患者发病风险和预后,但这些指标预测价值较低,计算复杂耗时,在临床应用中受到限制[3]。老年营养风险指数(geriatric nutritional risk index,GNRI)是一种可用于评估老年患者营养水平,计算简单且经济客观的指标,仅根据身高、体质量和血清白蛋白水平便可计算,常用于评价高危老年住院患者和脓毒症患者预后[4]。血尿酸(serum uric acid,SUA)是嘌呤代谢的最终产物,具有促氧化和抗氧化特性,与新型冠状病毒肺炎等疾病预后相关[5]。ARDS患者多伴有营养不良及SUA水平升高,但两者与ARDS患者预后是否相关,目前国内外研究报道较少。本研究探讨GNRI和SUA对老年ARDS患者预后的预测价值,以期为临床诊治提供理论依据。

1 对象与方法

1.1 研究对象

回顾性分析2018年1月至2021年9月中国人民解放军西部战区总医院收治的159例老年ARDS患者的临床资料。根据氧合指数分为轻度组[(200 mmHg<氧合指数≤300 mmHg(1 mmHg=0.133 kPa),35例]、中度组(100 mmHg<氧合指数≤200 mmHg,70例)和重度组(氧合指数≤100 mmHg,54例)。根据28 d预后情况分为生存组116例和死亡组43例。纳入标准:ARDS患者符合2012年"柏林定义"关于ARDS的诊断标准[6];发病时间≤24 h;年龄≥80岁。排除标准:诊断为ARDS后≤24 h死亡;患有血液性疾病、肿瘤、免疫系统疾病;严重肝肾功能衰竭;心力衰竭或容量过负荷引起的呼吸衰竭;患有肺癌、急性肺栓塞、肺结核及慢性阻塞性肺疾病等肺部疾病;入院前使用促尿酸排泄药物及其他原因引起的继发性SUA升高;中途转院或放弃治疗。

1.2 方法

收集患者基线资料,包括年龄、性别、体质量指数(body mass index,BMI)、既往病史、APACHE-Ⅱ、SOFA评分、氧合指数及ARDS致病原因等。所有患者入院时均采集空腹静脉血3 ml,以3 500转/min速度离心10 min分离血清,放置于−20℃冰箱保存备用,采用尿酸酶法检测SUA水平。计算GNRI,GNRI=1.489×血清白蛋白(g/L)+41.7×实际BMI/(22 kg/m^2)[7]。

1.3 统计学处理

采用SPSS 22.0软件对数据进行统计分析。计量资料呈正态分布者以均数±标准差($\bar{x}\pm s$)表示,组间比较采用单因素方差分析或独立样本t检验,多组间两两比较采用LSD-t检验;呈非正态分布者以中位数四分位数间距[$M(Q_1,Q_3)$]表示,组间比较采用Mann-Whitney U检验。计数资料以例数(百分率)表示,组间比较采用χ^2检验。相关性分析采用Pearson相关性分析法。采用受试者工作特征(receiver operating characteristic,ROC)曲线和Kaplan-Merier曲线分析GNRI和SUA对老年ARDS患者预后的评估价值。P<0.05为差异有统计学意义。

2 结 果

2.1 生存组和死亡组患者基线资料比较

本研究老年ARDS患者病死率为27.04%(43/159)。生存组和死亡组患者APACHE Ⅱ评分、SOFA评分、氧合指数和病情严重程度比较,差异均有统计学意义(P<0.05;表1)。

2.2 生存组和死亡组患者GNRI和SUA水平比较

与生存组相比,死亡组患者GNRI水平显著降低,SUA水平显著升高,差异均有统计学意义(均P<0.05;表2)。

表 1 生存组和死亡组患者基线资料比较

Table 1 Comparison of baseline data between survival group and death group

Item	Survival group (n=116)	Death group (n=43)	$t/\chi^2/Z$	P value
Age[years, $M(Q_1, Q_3)$]	90(85,93)	88(84,92)	1.166	0.244
Gender(Male/Female, n)	69/47	25/18	0.023	0.878
BMI(kg/m^2, $\bar{x}\pm s$)	21.97±3.72	21.56±3.26	0.642	0.522
APACHE Ⅱ[points, $M(Q_1, Q_3)$]	19.00(16.25,22.00)	24.00(21.00,27.00)	6.950	<0.001
SOFA[points, $M(Q_1, Q_3)$]	12(9,14)	14(10,16)	2.592	0.01
Diabetes mellitus[n(%)]	28(24.14)	11(25.58)	0.035	0.851
Hypertension[n(%)]	35(30.17)	15(34.88)	0.323	0.57
Dyslipidemia[n(%)]	12(10.34)	5(11.63)	0.054	0.816
$PaCO_2$[mmHg, $M(Q_1, Q_3)$]	37.95±10.69	36.84±11.30	0.576	0.565
Oxygenation index[mmHg, $M(Q_1, Q_3)$]	164.79±65.54	128.39±62.91	3.144	0.002
Severity of illness[n(%)]			10.116	0.006
Mild	29(25.00)	6(13.95)		
Moderate	56(48.28)	14(32.56)		
Severe	31(26.72)	23(53.49)		
Cause of disease[n(%)]			6.493	0.165
Pneumonia	42(36.21)	14(32.56)		
Non-pulmonary sepsis	25(21.55)	5(11.63)		
Aspiration	11(9.48)	8(18.60)		
Trauma	31(26.72)	10(23.26)		
Others	7(6.03)	6(13.95)		

BMI: body mass index; APACHE Ⅱ: acute physiology and chronic health evaluation Ⅱ; SOFA: sequential organ failure assessment. 1 mmHg=0.133 kPa.

表 2 生存组和死亡组患者 GNRI 和 SUA 水平比较

Table 2 Comparison of GNRI and SUA levels between survival group and death group ($\bar{x}\pm s$)

Group	n	GNRI(points)	SUA(μmol/L)
Survival	116	88.17±10.39	469.70±45.69
Death	43	77.42±7.06	544.46±63.97
t		7.431	7.028
P value		<0.001	<0.001

GNRI: geriatric nutritional risk index; SUA: serum uric acid.

2.3 不同病情患者 GNRI 和 SUA 水平比较

ARDS 重度组患者 GNRI 水平显著低于轻度组和中度组，SUA 水平显著高于轻度组和中度组，差异均有统计学意义（P<0.05；表 3）。

表 3 不同病情患者 GNRI 和 SUA 水平比较

Table 3 Comparison of GNRI and serum UA levels between survival group and death group ($\bar{x}\pm s$)

Group	n	GNRI(points)	SUA(μmol/L)
Mild	35	90.17±10.69	458.84±58.10
Moderate	70	85.81±10.15*	486.84±54.64*
Severe	54	81.37±10.14*#	514.05±61.52*#
F		7.979	9.861
P value		0.001	<0.001

GNRI: geriatric nutritional risk index; SUA: serum uric acid. Compared with mild group, *P<0.05; compared with moderate group, #P<0.05.

2.4 GNRI 和 SUA 水平与氧合指数的相关性分析

Pearson 相关性分析显示：氧合指数与 GNRI 呈正相关（r=0.412），与 SUA 呈负相关（r=−0.403），差异均有统计学意义（P<0.01）。

2.5 GNRI 和 SUA 水平对老年 ARDS 患者预后的预测价值

ROC 曲线分析显示：GNRI 和 SUA 预测老年 ARDS 患者预后的曲线下面积（area under curve，AUC）分别为 0.811（95%*CI* 0.744～0.878）和 0.830（95%*CI* 0.762～0.898），最佳截断点分别为 83.07 分和 493.13 μmol/L，灵敏度分别为 81.38% 和 81.40%，特异度分别为 70.69%和 71.55%。二者联合预测的 AUC 为 0.892（95%*CI* 0.841～0.943），灵敏度和特异度分别为 83.72% 和 81.90%（图 1）。Kaplan-Merier 曲线分析显示，与 GNRI ≥ 83.07 分患者相比，GNRI < 83.07 分患者 28 d 死亡率显著增加；与 SUA ≤ 493.13 μmol/L 患者相比，SUA > 493.13 μmol/L 患者 28 d 死亡率显著增加，差异均有统计学意义（P<0.05；图 2～3）。

3 讨 论

ARDS 具有死亡率高，预后差的特点，其发病率和病死率随年龄增加呈增长趋势[8]，为重症监护室常见疾病。研究表明[9]，营养素摄入减少会导致营养状况不佳，增加老年患者感染的风险。营养不良还会损害呼吸功能，增加肺炎风险。GNRI 用于评估老年患者营养状况，是预测长期护理的老年患者死亡率的评价指标[10]。杨琴等[11]研究发现，老年重症肺炎患者 GNRI 水平明显降低，且与病情严重程度和预后密切相关。Yoo 等[12]回顾性分析

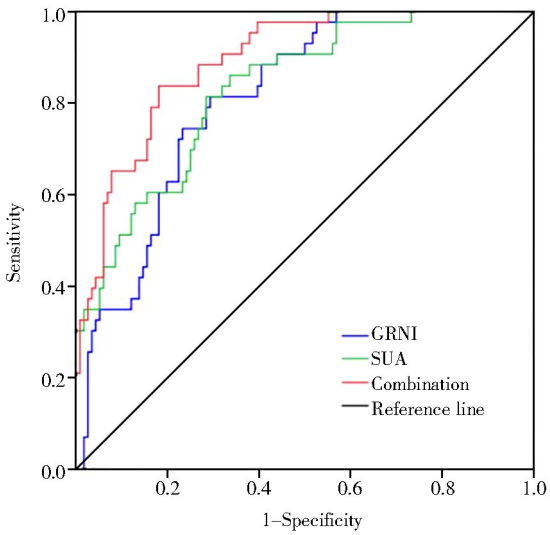


图 1 GNRI 和 SUA 预测老年 ARDS 患者预后的 ROC 曲线

Figure 1 ROC curve of GNRI and SUA in predicting prognosis of elderly patients with ARDS

GNRI: geriatric nutritional risk index; SUA: serum uric acid; ARDS: acute respiratory distress syndrome; ROC: receiver operating characteristic.

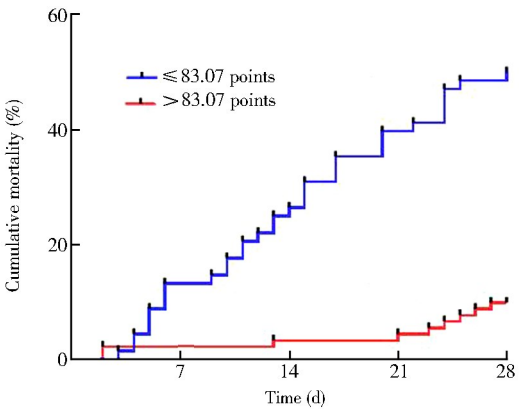


图 2 不同水平 GNRI 患者 28 d 死亡情况 Kaplan-Merier 曲线

Figure 2 Kaplan-Merier curve of 28 d mortality of patients with different levels of GNRI

GNRI: geriatric nutritional risk index.

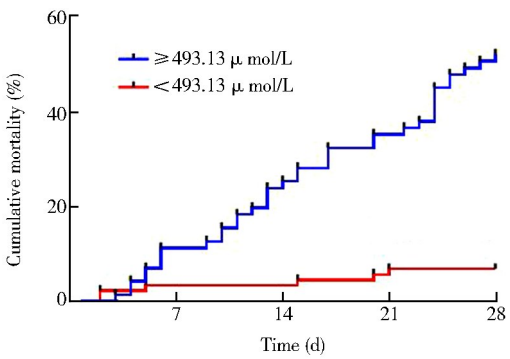


图 3 不同水平 SUA 患者 28 d 死亡情况 Kaplan-Merier 曲线

Figure 3 Kaplan-Merier curve of 28 d mortality of patients with different levels of SUA

SUA: serum uric acid.

224 例 ARDS 患者 30 d 预后情况，发现生存组 GNRI 水平高于死亡组，且 GNRI 水平越低，ARDS 患者死亡的风险越高，与本研究结果一致。本研究发现，死亡组老年 ARDS 患者 GNRI 水平较生存组低，且 GNRI 水平与氧合指数呈正相关。氧合指数作为肺部氧合状态的综合指标，能够反应患者肺部氧气交换功能，可评估 ARDS 患者的病情严重程度，其水平越低表明患者肺功能受损越严重。GNRI 水平越低代表体内蛋白质损耗越严重，而机体白蛋白水平降低会使血浆胶体渗透压降低，大量液体从肺血管渗入肺泡及肺间质，加剧肺间质水肿、加重肺损伤，从而加速 ARDS 患者病情恶化，影响患者预后[13]。且营养不良会降低宿主防御过程中对内源性营养物质的利用，致使患者免疫功能下降，感染风险增加，预后较差[14]。

SUA 作为代谢指标，除药物和高嘌呤饮食外，受其他因素影响较小，对调节肺和气道上皮细胞氧化应激具有重要意义[15]。Pehlivanlar-Kucuk 等[16]纳入 128 例重症患者的多中心前瞻性队列研究发现，死亡组患者 SUA 水平高于非死亡组，且当 SUA 水平高于 4.5 mg/dl 时，死亡风险增加 2.638 倍。本研究发现死亡组 SUA 水平较生存组高，且 SUA 水平与氧合指数呈正相关，提示 SUA 水平越高，肺损伤越严重，患者预后越差。许郭华等[17]研究发现，ARDS 患者 SUA 水平高于健康人群，且死亡组患者 SUA 水平高于生存组。Lee 等[18]研究发现，低 SUA 组 ARDS 患者预后优于高 SUA 组，且低 SUA 水平与较高的生存率显著相关，与本研究结果相似。可能原因为 ARDS 患者缺氧状态下会影响能量代谢，引起次黄嘌呤积累和尿酸大量生成。此外，ARDS 患者常伴有氧化应激，通过影响细胞膜通透性及信号传导，使能量代谢受到影响，也会造成 SUA 水平升高[19]。而高水平 SUA 能够激活内源性淋巴细胞、中性粒细胞和单核细胞，促使白细胞介素-1β（interleukin-1β，IL-1β）产生。IL-β 通过与 Toll 样受体信号结合，激活促炎转录因子，促进炎性因子的释放，从而使患者病情加重、预后变差[20]。

ROC 曲线分析结果显示：GNRI 联合 SUA 对老年 ARDS 患者预后具有较高的预测价值，优于单独应用。Kaplan-Merier 曲线分析结果显示，不同水平 GNRI 与 SUA 患者 28 d 病死率比较差异有统计学意义（$P<0.05$），进一步提示 GNRI 和 SUA 与老年 ARDS 患者预后相关。

综上所述，GNRI 和 SUA 水平与老年 ARDS 患者病情严重程度相关，二者联合应用对老年 ARDS 患者预后有较高的预测价值。但本研究为单中心回顾性研究，且未监测老年 ARDS 患者不同时期的 GNRI 和 SUA 水平，结果可能存在一定偏倚。今后还需开展多中心前瞻性研究，动态监测 GNRI 和 SUA 水平变化，进一步验证上述结果。

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