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◇临床医学研究◇

基于早产儿临床数据的列线图模型预测喘息发生的临床价值

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摘要 **目的** 探讨早产儿出院后婴儿期发生喘息的危险因素,并构建喘息的列线图模型。**方法** 选取早产儿 329 例,按照 7∶3 的比例随机分为训练集(n=232 例)及验证集(n=97 例),根据是否发生喘息将训练集分为喘息组(n=73 例)及非喘息组(n=159 例)。采用 Logistic 回归分析发生喘息的独立危险因素,利用 R 软件构建喘息的模型并进行验证。**结果** 与非喘息组相比,喘息组胎龄较小、机械通气、新生儿肺炎、1 周内动脉导管开放、肺动脉高压占比高、抗生素使用时间长等因素差异均有统计学意义(P<0.05);出生胎龄(OR:0.96,95% CI:0.95 ~ 0.98)、机械通气(OR:11.08,95% CI:6.36 ~ 19.31)、抗生素使用时长(≥1 周、<1 周)(OR:5.31,95% CI:3.19 ~ 8.84)、肺功能中 25% 潮气量的呼气流速(TEF25%)(OR:0.97,95% CI:0.95 ~ 0.99)、肺动脉高压(OR:12.06,95% CI:6.44 ~ 22.58)、新生儿肺炎(OR:4.79,95% CI:2.83 ~ 8.10)、半年内呼吸道感染次数(≥3 次、<3 次)(OR:5.18,95% CI:3.10 ~ 8.67)等是早产儿出院后婴儿期发生喘息的独立危险因素(P<0.05);训练集与验证集 ROC 曲线下面积分别是 0.889(95% CI:0.844 ~ 0.934)、0.959(95% CI:0.923 ~ 0.995);校准曲线与理想曲线基本吻合;决策曲线预测喘息的净获益值均较高。**结论** 基于早产儿喘息独立危险因素的列线图预测模型具有较高的准确性,能为临床工作提供一定的参考价值。

关键词 早产儿;喘息;肺功能;危险因素;列线图;预测模型

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随着我国全面生育政策的实施,早产发生率呈上升趋势[1]。早产儿由于多个系统发育尚未成熟,出生后易患新生儿呼吸窘迫综合征、支气管肺发育不良、慢性呼吸衰竭及包括哮喘在内的喘息性疾病[2]。喘息性疾病的发生受围产期因素、出生情况及生活环境等多种因素影响[3-4]。研究[5-8]表明,与足月儿相比,早产儿更易出现喘息甚至发展为哮喘,严重者还可能伴有情感交流障碍、注意力缺陷、睡眠障碍、焦虑和抑郁等问题。然而,目前国内外对早产儿出院后的随访工作仍存在不足,关于早产儿喘息预测模型的研究也极为有限。因此,加强早产儿出院后的系统随访,及早识别喘息高风险因素,并采取针对性干预和预防措施,对于降低喘息和哮喘的发生率、改善患儿生活质量、减轻家庭负担具有重要意义。

1 材料与方法

1.1 研究对象 选取 2020 年 9 月至 2023 年 10 月安徽医科大学第二附属医院新生儿重症监护室(neonatal intensive care unit, NICU)收治并在门诊正规随访的早产儿 329 例。入组标准:① 胎龄 <37 周的早产儿;② 出院后门诊正规随访至少至校正满 12 月龄并能配合完成问卷调查;③ 住院期间临床资料完整;④ 出院后于门诊完善肺功能检查。排除标准:① 非早产出生,即出生胎龄大于等于 37 周;② 住院疗程不足,放弃治疗的、临床资料欠缺的早产儿;③ 不能配合完成随访的早产儿;④ 合并严重先天畸形的早产儿等。本研究已通过安徽医科大学第二附属医院医学研究伦理委员会审批[批号:YX2021-055]。

1.2 诊断标准

1.2.1 早产儿诊断标准 早产儿指出生胎龄≥28 周并且 <37 周的新生儿。

1.2.2 喘息的诊断标准 喘息是较常见的呼吸系统疾患症状之一,主要表现为突然发作、胸闷气短、

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呼吸急促[5],严重时患儿可能会出现鼻翼扇动、胸骨上窝凹陷、肋间隙凹陷,主观感觉为呼吸费力或呼吸困难。查体时可在气管、肺部听到喘鸣音。

1.3 资料收集 收集早产儿孕母临床资料(有无胎膜早破、子痫、高血压、糖尿病、胎儿宫内窘迫、胎儿生长受限,分娩方式以及产前是否使用糖皮质激素等),早产儿临床资料(出生胎龄、出生体质量、抗生素使用情况、辅助通气情况、呼吸机使用时间,有无新生儿呼吸窘迫综合征、出生窒息、先天性甲状腺功能减退、黄疸、心肌损害、新生儿肺炎、动脉胆管未闭、肺动脉高压等),出院后门诊完善潮气肺功能监测以及校正满 12 月龄时调查问卷情况(家庭条件、喂养方式、居住环境、有无喂养宠物、呼吸道感染次数、家庭喘息病史等)。

1.4 统计学处理 采用 SPSS 26.0 软件进行数据分析。首先对数据进行正态性检验,符合正态分布的计量资料以 $\bar{x} \pm s$ 表示,不符合正态分布以中位数(四分位数)表示。符合正态分布的资料,两组组间比较采用独立样本 t 检验,不符合正态分布的资料两组组间比较采用 Mann- Whitney U 检验。计数资料采用 n(%)描述,采用卡方检验比较组间差异。对训练集进行单因素分析,然后采用多因素 Logistic 回归分析筛选出导致早产儿喘息的独立危险因素($P<0.05$)。运用 R 软件(R4.2.3)构建早产儿喘息的列线图模型,并绘制早产儿喘息模型的受试者工作特征(receiver operating characteristic,ROC)曲线,计算出曲线下面积(area under the curve,AUC),采用 ROC 曲线、校准曲线和决策曲线来评估该预测模型的准确性,将该模型应用于测试集进行再次验证。$P<0.05$ 为差异有统计学意义。

2 结果

2.1 模型组与验证组一般资料的比较 模型组与验证组在性别、机械通气与否、是否合并感染、抗生素使用时长、是否合并新生儿肺炎、支气管肺发育不良、1 周内动脉导管关闭情况、有无肺动脉高压、咖啡因、肺泡表面活性物质使用情况以及孕母有无宫内发育迟缓、宫内窘迫、妊娠合并糖尿病、妊娠合并子痫、呼吸道感染次数、家庭收入、有无喘息等资料比较差异无统计学意义。见表 1。

表 1 模型组与验证组的一般资料比较[n(%), $M(P_{25},P_{75})$]

Tab.1 Comparison of general data of the preterm infants between the model group and the verification group[n(%), $M(P_{25}, P_{75})$]

Index	The model group (n=232)	The verification group (n=97)	$\chi^2/t/U$ value	P value
Gender			0.01	0.923
Male	135 (58.19)	57 (58.76)		
Female	97 (41.81)	40 (41.24)		
Mechanical ventilation			1.22	0.269
No	142 (61.21)	53 (54.64)		
Yes	90 (38.79)	44 (45.36)		
NRDS			2.58	0.108
No	151 (65.09)	54 (55.67)		
Yes	81 (34.91)	43 (44.33)		
Infection			2.73	0.098
No	114 (49.14)	38 (39.18)		
Yes	118 (50.86)	59 (60.82)		
PDA within one week			0.04	0.833
Close	131 (56.47)	56 (57.73)		
Open	101 (43.53)	41 (42.27)		
PAH			<0.01	0.988
No	184 (79.31)	77 (79.38)		
Yes	48 (20.69)	20 (20.62)		
Neonatal pneumonia			0.29	0.592
No	174 (75.00)	70 (72.16)		
Yes	58 (25.00)	27 (27.84)		
Antibacterial drugs time(week)			3.38	0.066
<1	138 (59.48)	47 (48.45)		
≥1	94 (40.52)	50 (51.55)		
BPD			<0.01	>0.999
No	219 (94.40)	91 (93.81)		
Yes	13 (5.60)	6 (6.19)		

续表 1

Tab. 1 (Continued)

Index	The model group(n = 232)	The verification group(n = 97)	$\chi^2/t/U$ value	P value
Caffeine			0.85	0.357
No	183 (78.88)	72 (74.23)		
Yes	49 (21.12)	25 (25.77)		
PS			1.41	0.235
No	166 (71.55)	63 (64.95)		
Yes	66 (28.45)	34 (35.05)		
Combined antibacterial drugs			2.27	0.132
No	161 (69.40)	59 (60.82)		
Yes	71 (30.60)	38 (39.18)		
Premature rupture of membranes			1.29	0.256
No	150 (64.66)	69 (71.13)		
Yes	82 (35.34)	28 (28.87)		
Eclampsia			0.24	0.623
No	196 (84.48)	84 (86.60)		
Yes	36 (15.52)	13 (13.40)		
GDM			0.16	0.688
No	156 (67.24)	63 (64.95)		
Yes	76 (32.76)	34 (35.05)		
IUGR			0.45	0.500
No	225 (96.98)	96 (98.97)		
Yes	7 (3.02)	1 (1.03)		
Fetal distress			0.27	0.605
No	206 (88.79)	88 (90.72)		
Yes	26 (11.21)	9 (9.28)		
Prenatal glucocorticoids			1.51	0.219
No	164 (70.69)	75 (77.32)		
Yes	68 (29.31)	22 (22.68)		
Cesarean section			1.15	0.285
No	45 (19.40)	14 (14.43)		
Yes	187 (80.60)	83 (85.57)		
Family monthly income range(yuan)			4.44	0.218
<3 000	3 (1.29)	4 (4.12)		
3 001 – 5 000	88 (37.93)	41 (42.27)		
5 001 – 10 000	110 (47.41)	37 (38.14)		
>10 000	31 (13.36)	15 (15.46)		
The number of respiratory infections within six months(times)			0.86	0.355
<3	121 (52.16)	56 (57.73)		
≥3	111 (47.84)	41 (42.27)		
Wheezing			0.01	0.924
No	159 (68.53)	67 (69.07)		
Yes	73 (31.47)	30 (30.93)		
Gestational age at birth(d)	231.00 (217.00, 238.00)	231.00 (217.00, 238.00)	11 875.50	0.424
Height(cm)	49.00 (46.00, 52.00)	48.00 (46.00, 51.00)	11 940.50	0.381
Weight(kg)	2.90 (2.50, 3.63)	2.80 (2.50, 3.50)	11 906.50	0.405
VT	19.60 (15.50, 23.50)	18.10 (15.70, 22.20)	12 184.00	0.236
VT/KG	6.59 (5.67, 7.50)	6.76 (5.45, 7.70)	10 953.00	0.704
RR	56.00 (47.45, 67.10)	55.80 (48.50, 65.60)	11 198.00	0.946
TI/TE	0.81 (0.73, 0.91)	0.80 (0.73, 0.90)	11 925.50	0.392
TPTEF/TE	27.80 (20.70, 35.93)	26.09 (22.00, 35.50)	11 072.00	0.820
VPEF/VE	28.90 (24.65, 35.88)	28.80 (25.30, 35.10)	10 836.00	0.597
TEF75%	54.50 (41.75, 67.00)	53.00 (41.00, 69.00)	11 306.00	0.946
TEF50%	50.00 (40.00, 62.00)	51.00 (40.00, 63.00)	11 082.00	0.829
TEF25%	36.00 (29.75, 45.00)	36.00 (28.00, 44.00)	11 683.00	0.584

NRDS: neonatal respiratory distress syndrome; PAH: pulmonary arterial hypertension; BPD: bronchopulmonary dysplasia; PS: pulmonary surfactant; GDM: gestational diabetes mellitus; IUGR: intrauterine growth retardation; VT: tidal volume; RR: respiratory rate; TI/TE: inspiratory-expiratory phase time ratio; TPTEF/TE: time to peak tidal expiratory flow as a proportion of expiratory time; VPEF/VE: volume to peak tidal expiratory flow; TEF25%, TEF50%, TEF75%: 25%, 50%, 75% of expiratory flow of tidal volume.

2.2 喘息组和非喘息组一般资料的比较 与非喘息组相比,喘息组在出生胎龄、机械通气、新生儿肺炎、支气管肺发育不良、出院后期呼吸道感染次数、联合使用抗生素、使用肺泡表面活性物质、咖啡因、肺动脉高压、1 周内动脉导管开放、潮气量等方面 P 值均 <0.05。性别、孕母合并症、产前糖皮质激素使用情况、家庭收入、肺功能的其他指标差异无统计学意义($P>0.05$)。见表 2。

表 2 喘息组与非喘息组的一般资料比较[n(%), $M(P_{25},P_{75})$]

Tab. 2 Comparison of general data of the preterm infants between the wheezing group and the non-wheezing group[n(%), $M(P_{25},P_{75})$]

Index	The non-wheezing group(n=159)	The wheezing group(n=73)	$\chi^2/t/U$ value	P value
Gender			0.50	0.477
Male	95 (59.75)	40 (54.79)		
Female	64 (40.25)	33 (45.21)		
Mechanical ventilation			51.28	<0.001
No	122 (76.73)	20 (27.40)		
Yes	37 (23.27)	53 (72.60)		
NRDS			16.06	<0.001
No	117 (73.58)	34 (46.58)		
Yes	42 (26.42)	39 (53.42)		
Infection			17.69	<0.001
No	93 (58.49)	21 (28.77)		
Yes	66 (41.51)	52 (71.23)		
PDA within one week			26.99	<0.001
Close	108 (67.92)	23 (31.51)		
Open	51 (32.08)	50 (68.49)		
PAH			53.19	<0.001
No	147 (92.45)	37 (50.68)		
Yes	12 (7.55)	36 (49.32)		
Neonatal pneumonia			26.44	<0.001
No	135 (84.91)	39 (53.42)		
Yes	24 (15.09)	34 (46.58)		
Antibacterial drugs time(week)			25.17	<0.001
<1	112 (70.44)	26 (35.62)		
≥1	47 (29.56)	47 (64.38)		
BPD			4.39	0.036
No	154 (96.86)	65 (89.04)		
Yes	5 (3.14)	8 (10.96)		
Caffeine			8.84	0.003
No	134 (84.28)	49 (67.12)		
Yes	25 (15.72)	24 (32.88)		
PS			14.69	<0.001
No	126 (79.25)	40 (54.79)		
Yes	33 (20.75)	33 (45.21)		
Combined antibacterial drugs			8.78	0.003
No	120 (75.47)	41 (56.16)		
Yes	39 (24.53)	32 (43.84)		
Premature rupture of membranes			<0.01	0.953
No	103 (64.78)	47 (64.38)		
Yes	56 (35.22)	26 (35.62)		
Eclampsia			2.86	0.091
No	130 (81.76)	66 (90.41)		
Yes	29 (18.24)	7 (9.59)		
GDM			0.39	0.530
No	109 (68.55)	47 (64.38)		
Yes	50 (31.45)	26 (35.62)		
IUGR			<0.01	>0.999
No	154 (96.86)	71 (97.26)		
Yes	5 (3.14)	2 (2.74)		

续表 2

Tab. 2 (Continued)

Index	The non-wheezing group(n = 159)	The wheezing group(n = 73)	$\chi^2/t/U$ value	P value
Fetal distress			0.96	0.328
No	139 (87.42)	67 (91.78)		
Yes	20 (12.58)	6 (8.22)		
Prenatal glucocorticoids			0.25	0.618
No	114 (71.70)	50 (68.49)		
Yes	45 (28.30)	23 (31.51)		
Cesarean section			1.03	0.310
No	28 (17.61)	17 (23.29)		
Yes	131 (82.39)	56 (76.71)		
Family monthly income range(yuan)			4.33	0.228
<3 000	3 (1.89)	0 (0.00)		
3 000 – 5 000	62 (38.99)	26 (35.62)		
5 001 – 10 000	77 (48.43)	33 (45.21)		
>10 000	17 (10.69)	14 (19.18)		
The number of respiratory infections within six months(time)			35.57	<0.001
<3	104 (65.41)	17 (23.29)		
≥3	55 (34.59)	56 (76.71)		
Gestational age at birth(d)	238.00 (224.00, 245.00)	224.00 (210.00, 238.00)	7 609.00	<0.001
Height(cm)	49.00 (46.25, 52.00)	48.00 (46.00, 52.00)	6 224.50	0.375
Weight(kg)	3.00 (2.50, 3.70)	2.70 (2.30, 3.60)	6 540.00	0.120
VT	20.20 (16.25, 24.05)	18.40 (14.00, 22.10)	6 822.50	0.032
VT/KG	6.70 (5.79, 7.60)	6.44 (5.46, 7.37)	6 588.50	0.098
RR	54.20 (47.00, 67.65)	57.40 (47.70, 66.70)	5 390.50	0.385
TI/TE	0.82 (0.73, 0.90)	0.79 (0.72, 0.92)	6 030.00	0.634
TPTEF/TE	28.30 (20.67, 36.05)	26.56 (20.70, 31.67)	6 253.00	0.344
VPEF/VE	29.40 (24.45, 36.40)	28.60 (25.40, 33.90)	5 927.00	0.796
TEF75%	55.00 (42.00, 67.50)	52.00 (39.00, 62.00)	6 325.00	0.272
TEF50%	51.00 (41.50, 62.00)	46.00 (39.00, 62.00)	6 460.00	0.167
TEF25%	37.00 (31.00, 45.50)	35.00 (28.00, 42.00)	6 716.00	0.055

表 3 Logistic 回归分析影响早产儿喘息的发生因素

Tab. 3 Logistic regression analysis of risk factors for wheezing in Preterm Infants

Index	*SE*	*Wald*	*OR*(95% *CI*)	P value
Gestational age at birth	0.012	−2.84	0.96(0.95 – 0.98)	0.005
Antibacterial drugs time	0.416	2.01	5.31(3.19 – 8.84)	0.035
TEF25%	0.013	−2.14	0.97(0.95 – 0.99)	0.033
Mechanical ventilation	0.394	4.40	11.08(6.36 – 19.31)	<0.001
PAH	0.421	4.27	12.06(6.44 – 22.58)	<0.001
Neonatal pneumonia	0.409	2.70	4.79(2.83 – 8.10)	0.007
The number of respiratory infections within six months	0.378	5.76	5.18(3.10 – 8.67)	<0.001

2.3 早产儿出院后至校正满 12 月龄期间喘息的独立危险因素 在训练集中,将单因素分析有统计学意义的指标进行多因素 Logistic 回归分析,以 P < 0.05 为差异有统计学意义,结果见表 3。

2.4 早产儿出院后至校正满 12 月龄期间喘息的列线图模型构建 根据 Logistic 回归结果构建早产儿婴儿期喘息的列线图模型,总分 0 ~ 450 分,对应喘息发生的概率为 0.01 ~ 0.90。结果见图 1。模型组与验证组 ROC 曲线下面积分别为 0.889(95% *CI*:0.844 ~ 0.934)、0.959(95% *CI*:0.923 ~ 0.995)。模型组与验证组校准曲线与理想曲线基本吻合。模型组与验证组的决策曲线显示阈值概率在 1% ~ 70% 时,列线图预测喘息发生的净获益值较高。见图 2。

3 讨论

婴幼儿喘息是临床常见的气道慢性炎症性疾病之一,由肥大细胞激活,嗜酸性粒细胞、T 淋巴细胞活化浸润以及多种炎症介质共同参与所致。因其具

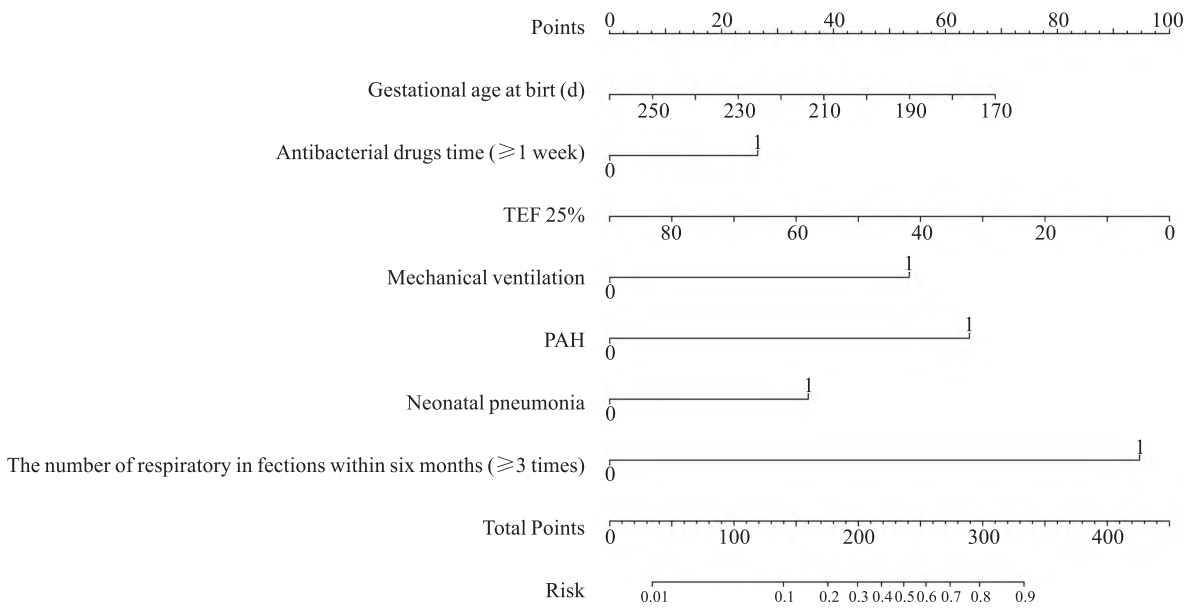

图 1　早产儿喘息的列线图预测模型

Fig. 1　The nomogram model of wheezing in preterm infants

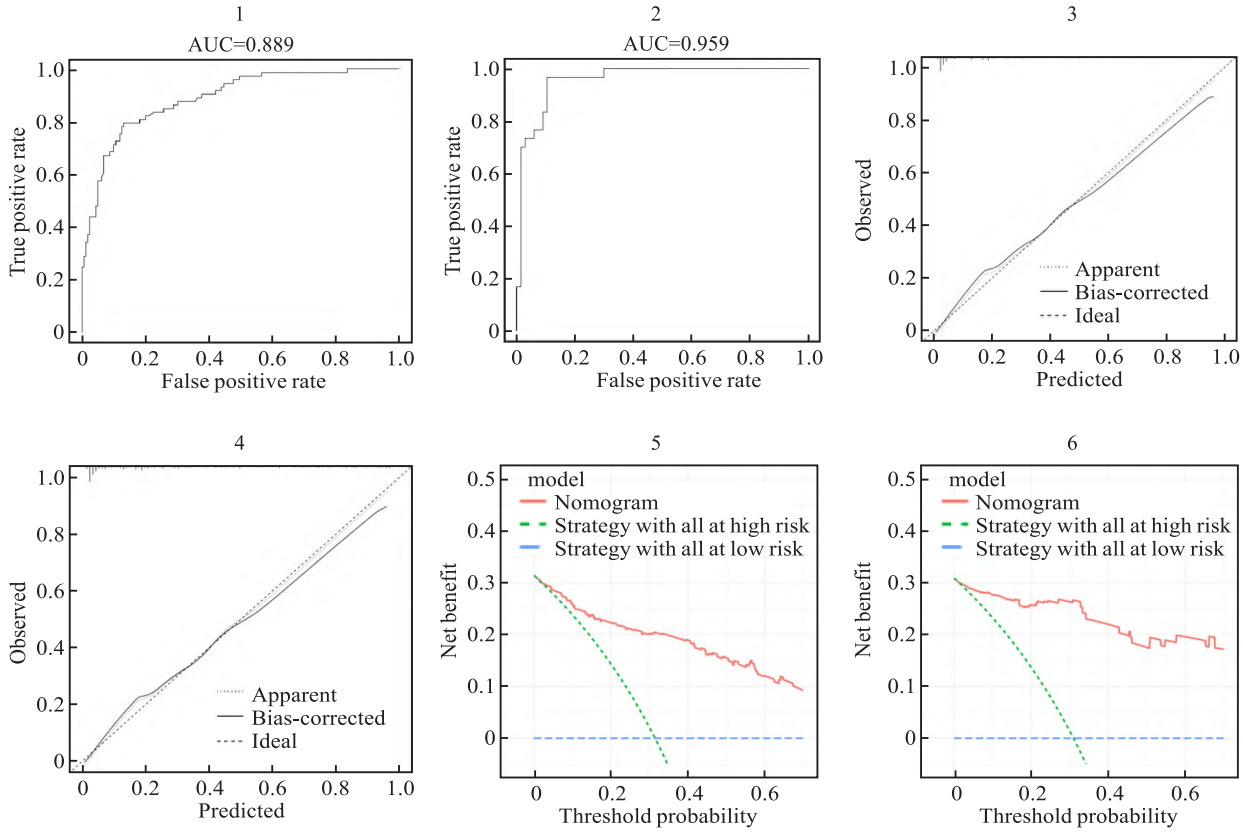

图 2　列线图模型的验证结果

Fig 2　The verification results of the nomogram model

1：ROC curve of model group；2：ROC curve of validation group；3：Calibration curve of model group；4：Calibration curve of validation group；5：Correction curve of model group；6：Correction curve of validation group.

有反复发作的特性,研究喘息的危险因素,预测喘息发生的概率,针对病因进行预防,从而达到早期干预、早期治疗的目的显得尤为重要。

既往有研究[9]表明反复呼吸道感染是导致婴幼儿喘息的危险因素之一。本文呼吸道感染次数(≥3 次)是早产儿出院后至校正满 12 月龄发生喘息的主要危险因素结果与之一致。但既往研究缺乏出生胎龄相关研究,本研究表明胎龄越小,发生喘息的可能性越大。早产可导致气道发育不全,纤毛运动功能障碍及气道上皮防御能力下降,增加呼吸道感染风险,反复感染可损伤气道功能,导致喘息[10-11]。因此,加强早产儿的感染防护,尽量降低其感染概率,可以减少喘息的发生。机械通气和新生儿肺炎也是早产儿发生喘息的风险因素。氧疗是早产儿治疗中的重要手段,但中度高氧(氧气浓度<60%)可通过影响支气管平滑肌细胞的增殖以及改变细胞外基导致气道反应性增加和重塑受损,从而增加气道疾病风险。机械通气可能通过压缩应力引发肺和其他器官的炎症及损伤[12-13]。咖啡因通过调节氧化应激反应,可减轻高氧诱导的肺氧化应激损伤[14]。因此,缩短机械通气时间、选择合适的通气模式辅以药物治疗,以减少相关肺损伤是必要的。住院早期使用抗生素时间≥1 周也与喘息风险增加有关。早期肠道菌群的多样性对免疫系统发育至关重要,长期抗生素使用可减少肠道菌群多样性,增加喘息和哮喘的风险[15-16]。所以,NICU 病房应注重病房消毒、医护人员手卫生,减少早产儿住院期间感染可能及抗生素使用时间。此外,早期肺动脉高压和潮气参数 TEF25% 低也被识别为喘息的预测因素。既往研究[17-18]表明,早发性喘息患者中合并肺动脉高压的风险增高,肺动脉高压可通过肺循环等多种病理生理过程导致气道反应性增加,进而增加喘息发生率。TEF25% 用于评估小气道功能,叶黄建 等[19]相关研究表明,喘息常常合并小气道功能障碍,小气道功能降低与喘息严重程度、喘息频率呈正相关。

肺功能检查在肺部疾病程度、进展及指导诊疗方面发挥着不可替代的作用[20],因需要患者的配合,在儿童中的应用有一定的限制,甚至缺乏对早产儿相关研究。既往研究多阐述喘息的发生发展机制,针对早产儿肺功能的随访研究比较罕见,该文通过监测早产儿出院后早期的肺功能指标,结合孕母孕期情况、早产儿住院期间的诊疗情况、并发症及辅助检查等数据,研究导致喘息的危险因素,进而构建预测模型,打破了既往人群发病率的局限性,此模型可量化各个变量,更好地预测每个个体发生喘息的概率,从而为每个患儿提供更加合理的个体化诊疗。

随着 NICU 技术的进步,早产儿成活率显著提高,但针对肺发育状况的研究相对较少,且目前尚无针对早产儿出院后至校正满 12 月龄期间喘息的预测模型。该研究基于多个危险因素构建了喘息的预测模型,能较准确地预测早产儿出院后至校正满 12 月龄期间发生喘息的概率。然而,本研究存在样本量小和随访时间短等局限,未来需通过延长随访时间和多中心数据共享,进一步优化模型。

综上所述,出生胎龄小、有机械通气、抗生素使用时长(≥1 周)、诊断新生儿肺炎、有肺动脉高压、半年内呼吸道感染次数(≥3 次)、TEF25% 低等是早产儿出院后婴儿期发生喘息的危险因素。基于临床数据的预测模型可为临床提供指导,及时采取干预措施,有效降低喘息乃至哮喘的发病率,提高早产儿的生活质量。

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Clinical value of a nomogram model based on preterm infants clinical data in predicting the occurrence of wheezing

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Abstract ***Objective*** To investigate the risk factors for wheezing during infancy in preterm infants after discharge and to develop a nomogram model for predicting wheezing. ***Methods*** A total of 329 preterm infants were selected for this study. The data were randomly divided into a training set ($n=232$) and a validation set ($n=97$) in a 7∶3 ratio. The training set was further divided into a wheezing group ($n=73$) and a non-wheezing group ($n=159$) based on the occurrence of wheezing. Logistic regression analysis was used to identify independent risk factors for wheezing, and the R software was used to construct and validate the predictive model. ***Results*** Compared with the non-wheezing group, the wheezing group had significantly lower gestational age, higher rates of mechanical ventilation, neonatal pneumonia, patent ductus arteriosus within 1 week, pulmonary hypertension, and prolonged antibiotic use ($P<0.05$). The independent risk factors for wheezing in preterm infants during infancy included gestational age (*OR*: 0.96, 95% *CI*: 0.95 - 0.98), mechanical ventilation (*OR*: 11.08, 95% *CI*: 6.36 - 19.31), duration

of antibiotic use (≥1 week *vs* <1 week, *OR*: 5.31, 95% *CI*: 3.19 – 8.84), 25% tidal volume expiratory flow rate (TEF25%) (*OR*: 0.97, 95% *CI*: 0.95 – 0.99), pulmonary hypertension (*OR*: 12.06, 95% *CI*: 6.44 – 22.58), neonatal pneumonia (*OR*: 4.79, 95% *CI*: 2.83 – 8.10), and frequency of respiratory infections in the first six months (≥3 times *vs* <3 times, *OR*: 5.18, 95% *CI*: 3.10 – 8.67) ($P < 0.05$). The areas under the ROC curve (AUC) for the training and validation sets were 0.889 (95% *CI*:0.844 – 0.934) and 0.959 (95% *CI*: 0.923 – 0.995), respectively. The calibration curve showed good agreement with the ideal curve, and decision curve analysis demonstrated high net benefit for predicting wheezing. ***Conclusion*** The nomogram model based on independent risk factors for wheezing in preterm infants provides a high level of accuracy and may serve as a useful reference for clinical practice.

Key words preterm infants; wheezing; pulmonary function; risk factors; nomogram; predictive model

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The effects of IgD on the proliferation and apoptosis of acute myeloid leukemia cells Molm-13

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Abstract ***Objective*** To investigate the role and related mechanisms of IgD on the viability, proliferation, apoptosis, and other functions of Molm-13 cells. ***Methods*** Peripheral blood serum was collected from AML patients and healthy controls. The sIgD levels were quantified by ELISA. For *in vitro* studies, Molm-13 cells were treated with varying concentrations of IgD. Cell viability and proliferation were assessed *via* CCK-8 assays, CFSE staining, and colony formation assays. Apoptosis rates were determined using an Annexin V/PI apoptosis detection kit. Preliminary exploration of the mechanisms related to IgD-induced proliferation of Molm-13 were analyzed through differential gene analysis. ***Results*** Compared with healthy controls, the levels of sIgD in AML patients were significantly elevated ($P < 0.001$). IgD treatment dose-dependently increased Molm-13 cell viability and proliferation ($P < 0.05$), inhibited apoptosis rates ($P < 0.001$). ***Conclusion*** IgD promotes the viability and proliferation of Molm-13 cells, and reduces apoptosis.

Key words acute myeloid leukemia; IgD; Molm-13; proliferation; apoptosis

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