



植入式静脉输液港患者导管阻塞风险预测模型的构建与验证*

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【摘要】目的 探讨植入式静脉输液港(implantable venous access port, IVAP)患者发生导管阻塞的影响因素,并构建风险预测模型。**方法** 回顾性选取2022年1月—2024年3月行IVAP置入的563例患者,按7:3比例随机分为建模组($n=394$)与验证组($n=169$)。采用单因素分析和多因素logistic回归(双向逐步回归法)筛选导管阻塞的独立影响因素,据此构建列线图预测模型,并分别从区分度、校准度及临床实用性三方面对模型进行验证与评估。**结果** 563例IVAP患者中,导管阻塞发生率为12.79%(72/563)。多因素logistic回归分析显示,体质指数(body mass index, BMI) ≥ 24 kg/m² (OR=3.535, 95%CI: 1.500~8.329)、合并糖尿病(OR=3.723, 95%CI: 1.540~8.999)、合并恶性肿瘤(OR=3.161, 95%CI: 1.327~7.526)、血栓史(OR=3.324, 95%CI: 1.425~7.755)、D-二聚体升高(OR=547.088, 95%CI: 46.093~649.462)及导管留置时间 ≥ 6 个月(OR=2.633, 95%CI: 1.060~6.543)是导管阻塞的独立危险因素,而定期维护(OR=0.200, 95%CI: 0.080~0.499)为其独立保护因素(均 $P<0.05$)。建模组受试者工作特征(receiver operating characteristic, ROC)曲线下面积(area under the curve, AUC)为0.91(95%CI: 0.87~0.96),验证组AUC为0.94(95%CI: 0.88~1.00); Hosmer-Lemeshow检验显示建模组($\chi^2=10.782$, $P=0.214$)与验证组($\chi^2=3.744$, $P=0.879$)模型拟合均良好;决策曲线分析(decision curve analysis, DCA)提示模型具有正向净临床收益。**结论** 本研究构建的IVAP导管阻塞风险预测模型具有良好的预测效能与临床实用价值,可为医护人员早期识别高危患者、实施个性化护理干预提供科学依据,有助于降低导管阻塞的发生风险。

【关键词】 植入式静脉输液港 导管阻塞 危险因素 预测模型

Construction and Validation of a Risk Prediction Model for Catheter Blockage in Patients With Implantable Venous Access Ports

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[Abstract] Objective To explore the influencing factors of catheter blockage in patients with implantable venous access ports (IVAP) and to construct a risk prediction model. **Methods** A total of 563 patients who underwent IVAP implantation from January 2022 to March 2024 were retrospectively enrolled and randomly divided into a modeling group ($n=394$) and a validation group ($n=169$) at a 7:3 ratio. Univariate analysis and multivariate logistic regression (bidirectional stepwise regression) were used to identify independent influencing factors for catheter blockage. A nomogram prediction model was then constructed and evaluated in terms of discrimination, calibration, and clinical utility. **Results** The incidence of catheter blockage was 12.79% (72/563). Multivariate Logistic regression showed that body mass index (BMI) ≥ 24 kg/m² (OR = 3.535, 95%CI: 1.500–8.329), diabetes mellitus (OR = 3.723, 95%CI: 1.540–8.999), malignancy (OR = 3.161, 95%CI: 1.327–7.526), history of thrombosis (OR = 3.324, 95%CI: 1.425–7.755), elevated D-dimer (OR = 547.088, 95%CI: 46.093–649.462), and catheter retention time ≥ 6 months (OR = 2.633, 95%CI: 1.060–6.543) were independent risk factors, while regular maintenance (OR = 0.200, 95%CI: 0.080–0.499) was an independent protective factor (all $P<0.05$). The area under the receiver operating characteristic curve (AUC) of the nomogram model was 0.91 (95%CI: 0.87–0.96) in the modeling group and 0.94 (95%CI: 0.88–1.00) in the validation

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group. The Hosmer-Lemeshow test showed good calibration for both the modeling group ($\chi^2 = 10.782, P = 0.214$) and the validation group ($\chi^2 = 3.744, P = 0.879$). Decision curve analysis indicated a positive net clinical benefit. **Conclusion** The IVAP catheter blockage risk prediction model constructed in this study demonstrates good predictive performance and clinical utility. It can assist healthcare providers in early identification of high-risk patients and implementation of individualized preventive interventions, thereby reducing the incidence of catheter blockage.

[Key words] Implantable venous access port Catheter blockage Risk factors Prediction model

植入式静脉输液港(implantable venous access port, IVAP)是一种完全植入皮下、可长期留置的封闭式静脉输液装置,广泛应用于肿瘤化疗、长期肠外营养支持等领域^[1]。该装置具有留置时间长、管理便捷、美观隐蔽及感染率低等优势,可为患者建立安全、稳定的静脉通路,有效减少反复穿刺所带来的痛苦^[2]。随着IVAP临床应用的日益普及,置管后相关并发症的问题也愈加受到关注^[3-4]。其中,导管阻塞是IVAP留置期间最常见且较为严重的非感染性并发症,不仅影响治疗药物的按时输注,延误患者病情,还可能导致非计划性拔管,增加患者痛苦及医疗负担^[5-6]。导管阻塞的发生机制复杂,既与导管自身结构、置管位置及临床操作规范密切相关,也受患者个体差异、基础疾病类型及治疗方案等多种因素影响^[7]。目前,针对导管阻塞的临床处理主要依赖于经验性措施,如导管冲洗、药物溶栓等^[8],但对于复杂病例,单纯依赖经验仍存在一定的局限性。因此,构建IVAP导管阻塞风险预测模型,对早期识别高危患者、实施个体化预防策略具有重要意义。本研究拟分析IVAP导管阻塞的影响因素,构建并验证风险预测模型,为临床决策提供参考。

1 对象与方法

1.1 研究对象

参照logistic回归分析样本量估算方法^[9],样本量需为自变量个数的10倍。本研究拟纳入25个自变量,考虑20%的无效样本,为保证模型稳定性,建模组至少需要样本量300例。最终纳入2022年1月—2024年3月于我院接受IVAP置入的患者563例,按置入时间顺序以7:3比例分为建模组($n=394$)与验证组($n=169$)。纳入标准:①年龄 ≥ 18 岁;②符合IVAP手术适应证^[10];③于我院行IVAP置入手术;④自愿参与研究并签署知情同意书。排除标准:①合并全身感染者;②凝血功能障碍者;③合并严重慢性阻塞性肺疾病者。本研究经徐州医科大学附属医院医学伦理委员会审批通过(XYFY2025-KL242-01)。

1.2 导管阻塞判断标准

导管阻塞判断标准^[11]如下:在排除导管扭曲或折叠的前提下,使用10 mL生理盐水行脉冲式冲管后,连接输

液器并调至最大流速。部分堵塞:推注有阻力但可输注,无法回抽见回血,滴速低于60滴/min。完全堵塞:推注阻力明显,无法回血及输注,输液完全阻断。符合任一情况即判为导管阻塞。据此将建模组分为阻塞组($n=51$)与未阻塞组($n=343$)。

1.3 资料收集

系统检索中英文数据库,结合临床经验确定预测变量。通过医院信息系统收集资料,包括:①一般资料:年龄、性别、体质指数(body mass index, BMI)、文化程度、吸烟史;②合并疾病:糖尿病、高血压、高血脂、恶性肿瘤、血栓史;③实验室指标:白细胞计数(white blood cell, WBC)、血红蛋白(hemoglobin, HGB)、白蛋白(albumin, ALB)、血小板计数(platelet count, PLT)、凝血酶原时间(prothrombin time, PT)、活化部分凝血活酶时间(activated partial thromboplastin time, APTT)、凝血酶时间(thrombin time, TT)、纤维蛋白原(fibrinogen, Fib)、D-二聚体;④IVAP相关信息:首次穿刺是否失败、操作时间、植入部位、导管留置时间、导管材质、定期维护等。

1.4 统计学方法

采用SPSS 27.0与R 4.4.0软件进行数据分析。定性资料以例数(百分比)描述,组间比较采用 χ^2 检验;正态分布的定量资料以 $\bar{x} \pm s$ 描述,组间比较采用独立样本 t 检验;偏态分布的定量资料以中位数(四分位间距)[$M(Q_1, Q_3)$]描述,组间比较采用非参数检验(Mann-Whitney U 检验)。采用多因素logistic回归(双向逐步回归法, $\alpha_A=0.05$, $\alpha_{出}=0.10$)筛选导管阻塞的独立影响因素,并绘制列线图。模型的预测性能评估包括:①区分度:通过受试者工作特征(receiver operating characteristic, ROC)曲线下面积(area under the curve, AUC)评估;②校准度:通过校准曲线和Hosmer-Lemeshow检验评估;③临床实用性:通过决策曲线分析(decision curve analysis, DCA)评估。以 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 患者基本情况

见表1。建模组与验证组患者的临床资料差异均无

表 1 建模组与验证组患者临床资料
Table 1 Clinical data of patients in the modeling group and validation group

Variable	Modeling group (<i>n</i> = 394)	Validation group (<i>n</i> = 169)	<i>t</i> / <i>Z</i> / χ^2	<i>P</i>
Age/yr.	59.57 ± 6.40	59.14 ± 6.78	0.72	0.471
Sex/case (%)			2.90	0.089
Male	201 (51.02)	73 (43.20)		
Female	193 (48.98)	96 (56.80)		
BMI/(kg/m ²)			0.04	0.845
< 24	239 (60.66)	104 (61.54)		
≥ 24	155 (39.34)	65 (38.46)		
Educational level/case (%)			0.00	0.949
Below high school	190 (48.22)	81 (47.93)		
High school or above	204 (51.78)	88 (52.07)		
Smoking history/case (%)			0.00	0.946
No	239 (60.66)	102 (60.36)		
Yes	155 (39.34)	67 (39.64)		
Diabetes/case (%)			0.30	0.587
No	297 (75.38)	131 (77.51)		
Yes	97 (24.62)	38 (22.49)		
Hypertension/case (%)			0.67	0.411
No	278 (70.56)	125 (73.96)		
Yes	116 (29.44)	44 (26.04)		
Hyperlipidemia/case (%)			0.02	0.895
No	294 (74.62)	127 (75.15)		
Yes	100 (25.38)	42 (24.85)		
Malignant tumor/case (%)			0.10	0.747
No	218 (55.33)	96 (56.80)		
Yes	176 (44.67)	73 (43.20)		
History of thrombosis/case (%)			0.03	0.865
No	284 (72.08)	123 (72.78)		
Yes	110 (27.92)	46 (27.22)		
WBC/(× 10 ⁹ L ⁻¹)	6.99 ± 1.61	6.96 ± 1.82	0.20	0.838
HGB/(g/L)	131.34 ± 10.26	132.01 ± 8.79	−0.79	0.429
ALB/(g/L)	43.00 (40.12, 45.27)	42.70 (39.90, 45.10)	−0.59	0.558
PLT/(× 10 ⁹ L ⁻¹)	193.72 ± 53.50	198.40 ± 57.41	−0.93	0.352
PT/s	10.95 (10.00, 12.00)	11.10 (10.20, 12.00)	−0.50	0.616
APTT/s	33.00 (29.00, 36.00)	33.00 (29.00, 37.00)	−0.16	0.872
Fib/(g/L)	3.00 (2.50, 3.50)	3.00 (2.50, 3.50)	−0.18	0.860
TT/s	12.44 ± 1.12	12.55 ± 1.12	−1.08	0.279
D-Dimer/(mg/L)	0.44 (0.29, 0.53)	0.44 (0.31, 0.52)	−0.22	0.825
Puncture frequency/case (%)			0.28	0.595
1 time	302 (76.65)	133 (78.70)		
> 1 time	92 (23.35)	36 (21.30)		
Operation time/min	29.72 ± 4.95	30.11 ± 4.41	−0.92	0.356
Implantation site/case (%)			0.02	0.892
Chest wall	319 (80.96)	136 (80.47)		
Upper arm	75 (19.04)	33 (19.53)		
Catheter retention time/case (%)			0.03	0.860
< 6 months	181 (45.94)	79 (46.75)		
≥ 6 months	213 (54.06)	90 (53.25)		
Catheter material/case (%)			0.34	0.560
Silica gel	218 (55.33)	98 (57.99)		
Polyurethane	176 (44.67)	71 (42.01)		
Regular maintenance/case (%)			0.10	0.754
No	60 (15.23)	24 (14.20)		
Yes	334 (84.77)	145 (85.80)		

统计学意义。563例IVAP患者中,共发生导管阻塞72例,发生率为12.79%(72/563),其中部分堵塞67例,完全堵塞5例。

2.2 建模组IVAP患者导管阻塞发生风险的单因素分析
对阻塞组和未阻塞组患者临床资料进行单因素分析,结果显示两组患者在年龄、性别、文化程度、吸烟

史、高血压、高血脂、白细胞计数、血红蛋白、白蛋白、血小板计数、PT、APTT、TT、Fib、首次穿刺是否失败、操作时间、植入部位和导管材质等方面,差异均无统计学

意义($P>0.05$); BMI、合并糖尿病、合并恶性肿瘤、血栓史、D-二聚体、导管留置时间和定期维护方面比较,差异均有统计学意义($P<0.05$),见表2。

表 2 IVAP导管阻塞发生风险的单因素分析

Table 2 Single factor analysis of the risk of catheter obstruction in IVAP patients

Variable	Unblocked group ($n = 343$)	Blocking group ($n = 51$)	$t/Z/\chi^2$	P
Age/yr.	59.69 ± 6.51	58.73 ± 5.61	1.01	0.314
Sex/case (%)			0.35	0.552
Male	173 (50.44)	28 (54.90)		
Female	170 (49.56)	23 (45.10)		
BMI/(kg/m ²)			27.07	< 0.001
< 24	225 (65.60)	14 (27.45)		
≥ 24	118 (34.40)	37 (72.55)		
Educational level/case (%)			0.61	0.436
Below high school	168 (48.98)	22 (43.14)		
High school or above	175 (51.02)	29 (56.86)		
Smoking history/case (%)			2.42	0.120
No	203 (59.18)	36 (70.59)		
Yes	140 (40.82)	15 (29.41)		
Diabetes/case (%)			13.24	< 0.001
No	269 (78.43)	28 (54.90)		
Yes	74 (21.57)	23 (45.10)		
Hypertension/case (%)			1.72	0.189
No	246 (71.72)	32 (62.75)		
Yes	97 (28.28)	19 (37.25)		
Hyperlipidemia/case (%)			0.11	0.745
No	255 (74.34)	39 (76.47)		
Yes	88 (25.66)	12 (23.53)		
Malignant tumor/case (%)			27.02	< 0.001
No	207 (60.35)	11 (21.57)		
Yes	136 (39.65)	40 (78.43)		
History of thrombosis/case (%)			15.48	< 0.001
No	259 (75.51)	25 (49.02)		
Yes	84 (24.49)	26 (50.98)		
WBC/($\times 10^9 \text{ L}^{-1}$)	7.04 ± 1.53	6.66 ± 2.03	1.28	0.204
HGB/(g/L)	131.25 ± 9.98	131.91 ± 12.12	-0.37	0.711
ALB/(g/L)	42.90 (39.90, 45.25)	43.40 (41.15, 45.55)	-1.23	0.221
PLT/($\times 10^9 \text{ L}^{-1}$)	196.00 (147.00, 238.00)	182.00 (143.50, 232.00)	-0.91	0.361
PT/s	10.80 (10.05, 12.00)	11.40 (9.95, 12.15)	-0.93	0.353
APTT/s	33.00 (29.00, 36.00)	33.00 (29.00, 36.00)	-0.12	0.901
Fib/(g/L)	12.44 ± 1.11	12.43 ± 1.14	0.05	0.958
TT/s	3.00 (2.40, 3.50)	3.00 (2.65, 3.50)	-0.76	0.448
D-Dimer/(mg/L)	0.41 (0.25, 0.50)	0.55 (0.49, 0.79)	-7.28	< 0.001
Puncture frequency/case (%)			0.46	0.498
1 time	261 (76.09)	41 (80.39)		
> 1 time	82 (23.91)	10 (19.61)		
Operation time/min	29.67 ± 5.07	30.06 ± 4.10	-0.61	0.546
Implantation site			1.58	0.208
Chest wall	281 (81.92)	38 (74.51)		
Upper arm	62 (18.08)	13 (25.49)		
Catheter retention time			18.88	< 0.001
< 6 months	172 (50.15)	9 (17.65)		
≥ 6 months	171 (49.85)	42 (82.35)		
Catheter material/case (%)			0.71	0.401
Silica gel	187 (54.52)	31 (60.78)		
Polyurethane	156 (45.48)	20 (39.22)		
Regular maintenance/case (%)			35.35	< 0.001
No	38 (11.08)	22 (43.14)		
Yes	305 (88.92)	29 (56.86)		

2.3 IVAP患者导管阻塞发生风险的多因素logistic回归分析

以IVAP患者是否发生导管阻塞为因变量(未发生=0,发生=1),将单因素分析中差异有统计学意义的7个变量(BMI、糖尿病、恶性肿瘤、血栓史、D-二聚体、导管留置时间、定期维护)作为自变量纳入多因素logistic回归分析(双向逐步回归, $\alpha_{\text{入}}=0.05$, $\alpha_{\text{出}}=0.10$)。自变量赋值方式: BMI($<24\text{ kg/m}^2=0$, $\geq 24\text{ kg/m}^2=1$)、糖尿病(否=0,是=1)、恶性肿瘤(否=0,是=1)、血栓史(否=0,是=1)、D-二聚体(连续变量,原值输入)、导管留置时间(<6 个月=0, ≥ 6 个月=1)、定期维护(否=0,是=1)。多因素logistic回归分析结果显示, BMI $\geq 24\text{ kg/m}^2$ 、合并糖尿病、合并恶性肿瘤、血栓史、D-二聚体和导管留置时间 ≥ 6 个月是导管阻塞发生的独立危险因素,定期维护是导管阻塞发生的独立保护因素($P<0.05$)(表3)。

2.4 IVAP患者导管阻塞列线图风险预测模型的构建

基于上述7项独立影响因素,构建IVAP患者导管阻塞风险预测列线图模型,见图1。使用时,将模型中各因

素对应的单项分值相加得到总分,总分在列线图顶端所对应的预测概率值,即为该患者发生导管阻塞的风险概率。

2.5 IVAP患者导管阻塞风险预测模型的评价与验证

建模组与验证组预测IVAP患者导管阻塞风险的ROC曲线见图2,建模组和验证组的AUC(95%CI)分别为0.91(0.87~0.96)和0.94(0.88~1.00)。校准曲线分析显示,建模组与验证组的实际概率与预测概率曲线均基本吻合(图3)。Hosmer-Lemeshow检验结果显示,建模组 $\chi^2=10.782$, $P=0.214$;验证组 $\chi^2=3.744$, $P=0.879$,均大于0.05,说明模型拟合良好。DCA曲线分析结果显示,建模组与验证组的模型净收益曲线均高于全干预线与不干预线,提示模型具有正向净临床收益,具备良好的临床实用价值(图4)。

3 讨论

3.1 IVAP患者导管阻塞的发生情况

导管阻塞是IVAP置入后常见的并发症之一,不仅影响输液港的临床使用效果,延误治疗进程,还可能降低患

表 3 IVAP患者导管阻塞发生风险的多因素Logistic回归分析结果

Table 3 Multivariate logistic regression analysis results of catheter obstruction risk in IVAP patients

Variable	β	SE	Z	P	OR (95%CI)
Intercept	-6.799	1.003	-6.775	< 0.001	0.001 (0.000-0.008)
BMI	1.263	0.437	2.888	0.004	3.535 (1.500-8.329)
Diabetes	1.314	0.450	2.919	0.004	3.723 (1.540-8.999)
Malignant tumor	1.151	0.443	2.600	0.009	3.161 (1.327-7.526)
History of thrombosis	1.201	0.432	2.780	0.005	3.324 (1.425-7.755)
D-Dimer	6.305	1.262	4.995	< 0.001	547.088 (46.093-6493.462)
Catheter retention time	0.968	0.464	2.085	0.037	2.633 (1.060-6.543)
Regular maintenance	-1.608	0.466	-3.453	< 0.001	0.200 (0.080-0.499)

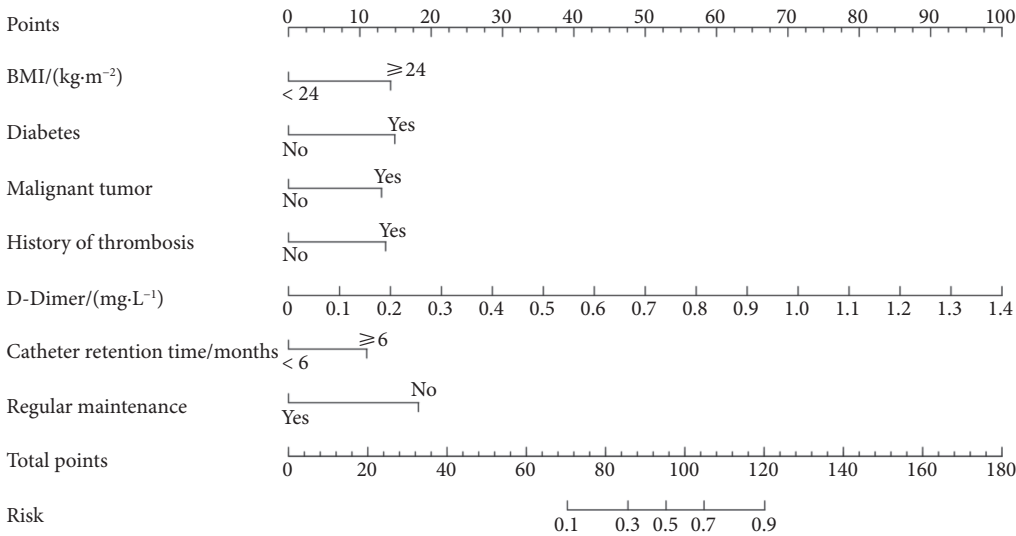


图 1 IVAP患者导管阻塞列线图模型

Fig 1 Cumulative incidence plot model of catheter obstruction in IVAP patients

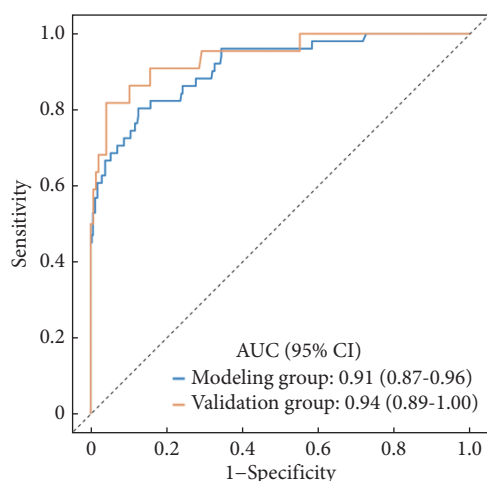


图 2 建模组和验证组ROC曲线

Fig 2 ROC curves of the modeling group and validation group

者的生活质量。本研究结果显示, 563例IVAP患者中, 导管阻塞发生率为12.79%, 与杨婷婷等^[12]报道的15.22%接近, 但高于Han等^[13]报道的5%, 这可能与研究对象、判断标准和医护人员的操作、抽样误差、研究偏倚等有关。

3.2 IVAP患者导管阻塞影响因素分析

本研究发现BMI ≥ 24 kg/m²、合并糖尿病、合并恶

性肿瘤、血栓史、D-二聚体和导管留置时间 ≥ 6 个月是导管阻塞发生的独立危险因素, 定期维护是导管阻塞发生的独立保护因素。

BMI较高的患者常伴随代谢紊乱, 血液黏稠度较高, 容易形成血栓进而堵塞导管^[14]。合并糖尿病患者体内的高血糖环境会对血管内皮造成持续性的损伤, 破坏血管内皮完整性, 且糖尿病患者红细胞变形能力降低、血小板黏附聚集性增加, 血流动力学改变, 增加了导管堵塞的风险^[15]。恶性肿瘤患者血液往往呈现高凝状态, 这是由于肿瘤细胞释放促凝因子, 导致血管内皮细胞损伤, 激活外源性和内源性凝血途径, 使机体处于高凝状态, 使得导管堵塞风险攀升^[16]。有血栓史的患者更容易发生导管堵塞, 这是由于有血栓史的患者局部血管内膜已经受到损伤, 促使血小板在内膜显露处黏附并释放由血小板衍生的生长因子, 引起血管内膜的反复损伤, 更容易形成血栓堵塞导管^[15]。D-二聚体是凝血与纤溶激活的标志物, 其水平升高明确指示体内凝血系统正处于活跃状态, 纤维蛋白降解增多。在植入静脉输液港的情境下, D-二聚体水平过高预示着导管局部微环境更易发生凝血级联反应, 凝血块不断累积直至堵塞导管, 为早期识别高风险患

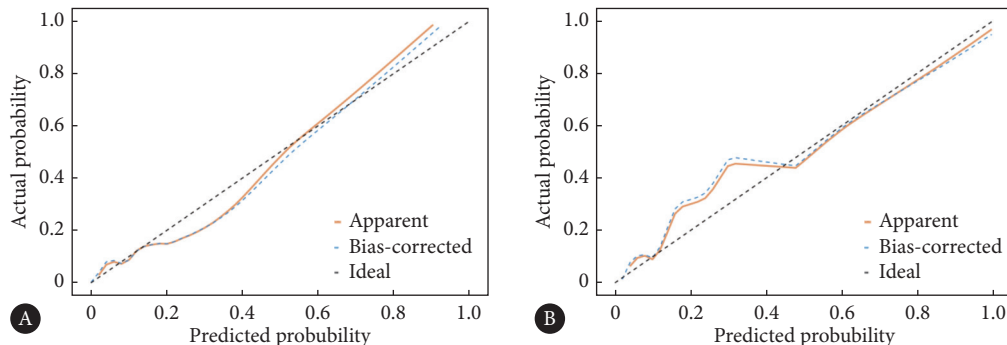


图 3 建模组和验证组校准曲线

Fig 3 Calibration curves of the modeling group and validation group

A, modeling group; B, validation group.

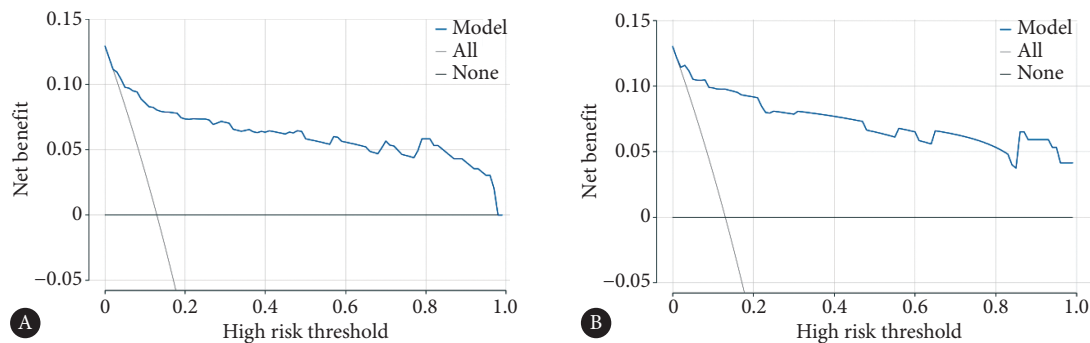


图 4 建模组和验证组DCA曲线

Fig 4 DCA curves of the modeling group and validation group

A, modeling group; B, validation group.

者提供关键线索^[17]。这些结果提示针对高风险患者,如肥胖合并恶性肿瘤者,可强化监测频率,不仅关注D-二聚体动态变化,更要提前拟定个体化抗凝方案,在不增加出血风险的前提下,降低凝血风险。

导管留置时间过长,容易在导管前端形成纤维蛋白鞘,导致回抽困难或注射不顺畅。同时,随着导管的长期使用,部分患者导管内壁有药物或血液沉积,从而提升导管堵塞的风险^[18]。定期维护输液港,并规范冲管,可以防止长期使用导致管壁残余沉淀附着面积增大。研究表明输液港应用患者非治疗维护时间间隔6周以上,堵管发生率高达19.23~25.93%^[19]。这提示对于导管留置时间较长的患者,应该监督患者每四周维护一次,加强医护人员培训,确保每次维护操作精准无误,最大程度减少导管堵塞发生率,优化植入式静脉输液港的使用效能,提升患者长期治疗体验与安全性。

3.3 IVAP患者导管阻塞风险预测模型具有实用价值

了解导管阻塞的危险因素,建立科学有效的风险评估工具,有利于早期识别导管阻塞高风险IVAP患者,进而采取针对性的预防措施。目前已有部分研究分析了输液港置入患者导管阻塞的危险因素,然而这些研究多针对恶性肿瘤患者,且未构建风险预测模型^[20]。本研究通过单因素分析和多因素Logistic回归分析确定独立影响因素,基于此进一步构建了列线图风险评估模型,该模型纳入的影响因素相关信息易获取,列线图简单直观,易于理解和解读,能够帮助临床医护人员快速了解病人的风险概率,及时做出相应的决策,也有利于患者进行自我管理,减少导管阻塞的发生。有学者建立了其他中心静脉导管装置堵塞的风险预测模型,如张晓芬等^[15]构建的公式化模型,需要进行计算不够直观;李钦领等^[21]基于重症患者PICC导管堵塞影响因素构建了列线图模型,但未进行DCA曲线分析。本研究建模组和验证组ROC曲线AUC为0.91和0.94,高于张晓芬等^[15]和李钦领等^[21]报道的0.745和0.738;校准曲线和Hosmer-Lemeshow检验显示模型拟合良好,DCA曲线显示模型具有净获益,这些结果充分说明了模型具有良好的预测价值和实用价值。

综上,本研究通过单因素分析和多因素Logistic回归分析,发现BMI ≥ 24 kg/m²、合并糖尿病、合并恶性肿瘤、血栓史、D-二聚体、导管留置时间 ≥ 6 个月和定期维护是导管阻塞发生的独立影响因素,基于此构建的风险预测模型具有良好的预测价值和临床实用价值。本研究为临床预警导管阻塞发生提供了科学的评估工具,有助于医护人员科学管理输液港,改善患者治疗体验和预后。但本研究为单中心回顾性研究,样本代表性局限,可

能未充分纳入其他潜在影响因素,存在一定的偏倚性,仍需多中心、大样本研究进行外部验证,以优化模型。

* * *

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Author Contribution Zhang Shuang is responsible for conceptualization, formal analysis, funding acquisition, investigation, and writing--original draft. Han Suli is responsible for data curation, formal analysis, methodology, and validation. Zhao Ningjun is responsible for project administration, resources, supervision, and writing--review and editing. All authors consented to the submission of the article to the Journal. All authors approved the final version to be published and agreed to take responsibility for all aspects of the work.

利益冲突 所有作者均声明不存在利益冲突

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