

• 临床研究 •

^{99m}Tc-MIBI SPECT/CT 联合临床在肾性继发性甲状旁腺功能亢进甲状旁腺切除术后骨饥饿综合征的应用

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[摘 要] 目的: 探讨^{99m}锝-甲氧基异丁基异腈(^{99m}Tc-methoxyisobutylisonitrile, MIBI)单光子发射计算机断层显像/计算机断层扫描(single-photon emission computed tomography/computed tomography, SPECT/CT)显像甲状旁腺数目、术前生化指标及外周血炎症指数与肾性继发性甲状旁腺功能亢进(secondary hyperparathyroidism, SHPT)甲状旁腺切除术(parathyroidectomy, PTX)后骨饥饿综合征(hungry bone syndrome, HBS)的关系。方法: 回顾性分析2014年6月—2025年3月南通大学附属江阴医院成功行PTX的113例肾性SHPT患者的临床与影像资料, 根据PTX术后是否发生HBS分为HBS组及非HBS组。比较两组间各指标的差异, 应用多因素Logistic回归分析HBS的危险因素。采用受试者工作特征(receiver operating characteristic, ROC)曲线确定最佳截断值。结果: 113例中HBS组63例, 非HBS组50例。两组间年龄[(47.4±10.8)岁 vs. (54.1±9.2)岁, $P=0.001$]、术前碱性磷酸酶(alkaline phosphatase, ALP)[322.70(191.00, 636.10)U/L vs. 159.05(122.85, 221.88)U/L, $P<0.001$]、术前甲状旁腺激素[171.10(114.00, 227.30)pmol/L vs. 120.95(98.40, 163.18)pmol/L, $P=0.003$]、术前校正钙[2.43(2.24, 2.53)mmol/L vs. 2.51(2.39, 2.61)mmol/L, $P=0.024$]、SPECT/CT显像甲状旁腺≥4枚[74.6%(47/63) vs. 38.0%(19/50), $P<0.001$]及预后营养指数(prognostic nutritional index, PNI)[49.95(46.20, 52.00) vs. 46.60(43.74, 50.10), $P=0.003$]差异均有统计学意义。多因素Logistic回归分析示术前ALP(OR=1.005, 95%CI: 1.002~1.009, $P=0.002$)、SPECT/CT显像甲状旁腺≥4枚(OR=3.166, 95%CI: 1.235~8.113, $P=0.016$)及PNI(OR=1.112, 95%CI: 1.013~1.221, $P=0.026$)为HBS的独立影响因素。ROC曲线确定术前ALP及PNI的最佳截断值为278.0 U/L、44.925。术前ALP≥278.0 U/L、SPECT/CT显像甲状旁腺≥4枚及PNI≥44.925联合应用诊断HBS的灵敏度为98.4%, 优于单独应用, 差异有统计学意义(P 均 <0.05)。结论: 术前ALP、SPECT/CT显像甲状旁腺≥4枚及PNI为肾性SHPT术后HBS的独立影响因素; 联合术前ALP≥278.0 U/L、SPECT/CT显像≥4枚及PNI≥44.925诊断HBS灵敏度高, 具有良好的临床应用价值。

[关键词] 继发性甲状旁腺功能亢进症; ^{99m}Tc-MIBI SPECT/CT; 甲状旁腺激素; 骨饥饿综合征; 炎症标志物

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The application of ^{99m}Tc - MIBI SPECT/CT combined clinical indicators on hungry bone syndrome after parathyroidectomy for renal secondary hyperparathyroidism

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[Abstract] **Objective:** To investigate the relationship between the number of parathyroid gland on ^{99m}Tc-methoxyisobutylisonitrile (MIBI) single-photon emission computed tomography/computed tomography (SPECT/CT), preoperative laboratory parameters, peripheral blood inflammatory markers on bone hungry syndrome (HBS) after parathyroidectomy (PTX) in patients with renal secondary hyperparathyroidism (SHPT). **Methods:** The clinical and imaging data of 113 renal SHPT patients who underwent PTX in the Affiliated Jiangyin Hospital of Nantong University from Jun 2014 to Mar 2025 were retrospectively analyzed. The patients were divided into the HBS group and non-HBS group based on whether occurred HBS. Differences in various indices between the two groups were compared, multivariate logistic regression was used to analyze the influencing factors of HBS. The receiver operating characteristic

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(ROC) curve was used to determine the optimal cut-off value. **Results:** Of all 113 patients, there were 63 patients in the HBS group and 50 patients in the non-HBS group. There were significant differences in age [(47.4 ± 10.8) years *vs.* (54.1 ± 9.2) years, $P=0.001$], preoperative alkaline phosphatase (ALP) [$(322.70(191.00, 636.10))$ U/L *vs.* $(159.05(122.85, 221.88))$ U/L, $P < 0.001$], preoperative parathyroid hormone [$(171.10(114.00, 227.30))$ pmol/L *vs.* $(120.95(98.40, 163.18))$ pmol/L, $P=0.003$], preoperative corrected calcium [$(2.43(2.24, 2.53))$ mmol/L *vs.* $(2.51(2.39, 2.61))$ mmol/L, $P=0.024$], the number of SPECT/CT parathyroid gland ≥ 4 [$74.6\%(47/63)$ *vs.* $38.0\%(19/50)$, $P<0.001$], and prognostic nutritional index (PNI) [$(49.95(46.20, 52.00))$ *vs.* $(46.60(43.74, 50.10))$, $P=0.003$] between the two groups. Multivariate logistic regression showed that preoperative ALP (OR=1.005, 95%CI: 1.002–1.009, $P=0.002$), the number of SPECT/CT parathyroid gland ≥ 4 (OR=3.166, 95%CI: 1.235–8.113, $P=0.016$), and PNI (OR=1.112, 95%CI: 1.013–1.221, $P=0.026$) were independent risk factors for HBS. The ROC curve determined the optimal cut-off values of preoperative ALP and PNI as 278.0 U/L and 44.925. The combination of preoperative ALP ≥ 278.0 U/L, the number of SPECT/CT parathyroid gland ≥ 4 and PNI ≥ 44.925 achieved sensitivity of 98.4% for diagnosing HBS, which were higher than individual indicator (all $P < 0.05$). **Conclusion:** The preoperative ALP, the number of SPECT/CT parathyroid gland ≥ 4 , and PNI were independent influencing factors for HBS, combined preoperative ALP ≥ 278.0 U/L, the number of SPECT/CT parathyroid gland ≥ 4 and PNI ≥ 44.925 demonstrates high sensitivity in diagnosing HBS, thus have good clinical value.

[Key words] secondary hyperparathyroidism; ^{99m}Tc -MIBI SPECT/CT; parathyroid hormone; hungry bone syndrome; inflammatory marker
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骨饥饿综合征(hungry bone syndrome, HBS)是甲状旁腺功能亢进症或术前有高骨转换状态患者行甲状旁腺切除(parathyroidectomy, PTX)术后出现以低钙血症为主要表现的临床综合征,多见于肾性继发性甲状旁腺功能亢进(secondary hyperparathyroidism, SHPT)患者,可延长患者住院时间甚至增加死亡风险^[1-2],临床应早期识别并积极处理HBS,以降低围手术期风险。 ^{99m}Tc -甲氧基异丁基异腈(^{99m}Tc -methoxyisobutylisonitrile, ^{99m}Tc -MIBI)单光子发射计算机断层显像/计算机断层扫描(single-photon emission computed tomography/computed tomography, SPECT/CT)为肾性SHPT行PTX术前首选的影像学检查方法^[3-5],SPECT/CT衍生参数也已初步应用于HBS临床实践^[6-7]。

基于外周血细胞计数衍生的炎症标志物如中性粒细胞/淋巴细胞比值(neutrophil to lymphocyte ratio, NLR)、血小板/淋巴细胞比值(platelet to lymphocyte ratio, PLR)、单核细胞/淋巴细胞比值(monocyte to lymphocyte ratio, MLR)、全身免疫炎症指数(systemic immune inflammation index, SII)及预后营养指数(prognostic nutritional index, PNI)在炎症和免疫反应中起重要作用,与慢性肾脏病透析患者不良事件、心血管病死亡风险及全因死亡有关^[8-10]。目前,外周血炎症指数与肾性SHPT患者PTX术后HBS的关系尚不明确。本研究回顾分析经手术及病理证实的113例肾性SHPT的 ^{99m}Tc -MIBI SPECT/CT影像及

临床资料,分析 ^{99m}Tc -MIBI SPECT/CT显像甲状旁腺数目、术前生化指标及外周血炎症指数与HBS间的关系,为临床诊疗决策提供参考依据。

1 对象和方法

1.1 对象

回顾性分析2014年6月—2025年3月在南通大学附属江阴医院乳甲外科成功行PTX的113例肾性SHPT患者,其中男63例,女50例,平均年龄 (50.4 ± 10.6) 岁。透析龄 $96(60, 120)$ 个月。纳入标准:①年龄 >18 周岁,且规律透析时间 >12 个月;②采用甲状旁腺全切术加自体移植术,手术指征参照2021版中国医师协会外科医师分会甲状腺外科医师委员会《慢性肾脏病继发甲状旁腺功能亢进外科临床实践中国专家共识》^[11],术中切除甲状旁腺数 ≥ 3 枚,且术后24 h甲状旁腺激素(parathyroid hormone, PTH) <6.3 pmol/L;③术前行 ^{99m}Tc -MIBI SPECT/CT甲状旁腺显像,显像与手术间隔 <2 周。排除标准:①合并恶性肿瘤、骨髓瘤、造血系统疾病及免疫系统疾病;②既往行PTX或接受甲状旁腺消融术;③影像或临床资料不完整。本研究经医院伦理委员会审核批准,批文号:2023伦审研第(065)号。通过电子病历系统获得患者的临床资料(年龄、性别、透析龄),术前实验室指标包括:碱性磷酸酶(alkaline phosphatase, ALP)、PTH、血钙、血磷、血清白蛋白、中性粒细胞计数、淋巴细胞计数、血小板计数以及单

核细胞计数。计算校正钙(mmol/L)=血钙(mmol/L)+0.02×[40-血清白蛋白(g/L)],NLR=中性粒细胞计数/淋巴细胞计数,PLR=血小板计数/淋巴细胞计数,MLR(%)=单核细胞计数/淋巴细胞计数×100%,SI($\times 10^9$ 个/L)=血小板计数×中性粒细胞计数/淋巴细胞计数,PNI=血清白蛋白+淋巴细胞计数×5。临床参考值:ALP 40~120 U/L,PTH 1.3~9.3 pmol/L,血钙 2.00~2.75 mmol/L,血磷 0.80~1.50 mmol/L。

1.2 方法

1.2.1 术后补钙方法及HBS定义

术后立即予5%葡萄糖30 mL与10%葡萄糖酸钙30 mL稀释后以10~20 mL/h的速度输液泵或静脉滴注;如出现肢体麻木、抽搐等症状,临时静脉推注10%葡萄糖酸钙10~20 mL;每24 h检测血钙、血磷及PTH,根据血钙水平及时调整补钙速度。

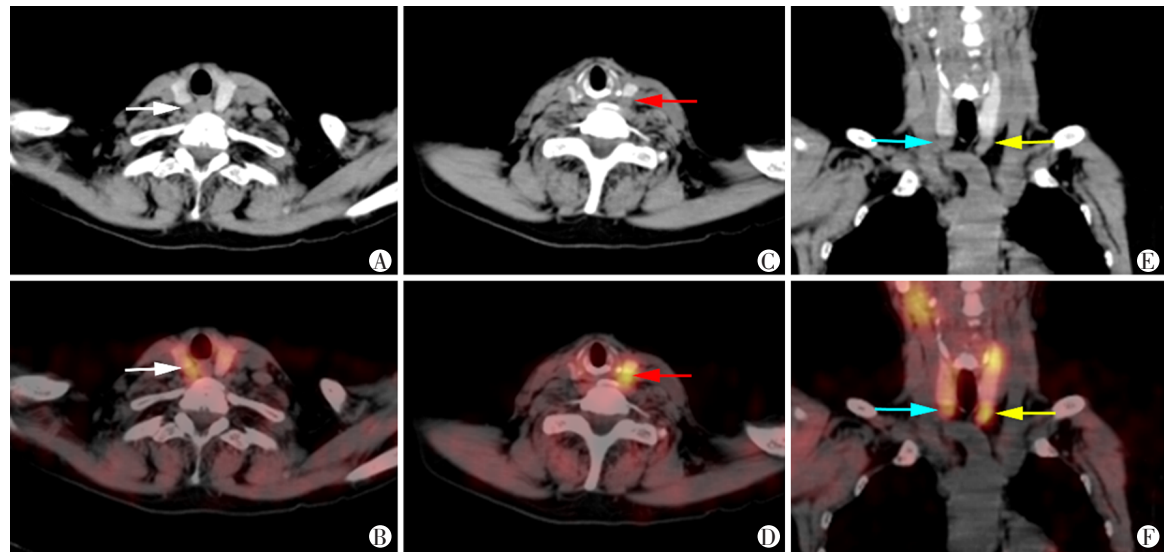
HBS定义为PTX术后即刻至术后120 h动态监测血钙过程中,至少出现1次血钙<2.1 mmol/L^[2],基于此将患者分为HBS组及非HBS组。

1.2.2 ^{99m}Tc-MIBI SPECT/CT甲状旁腺显像方法及图像分析

注射^{99m}Tc-MIBI(上海欣科医药有限公司苏州分

公司提供,放射化学纯度>95%)740~925 MBq,分别于注射15 min、2 h后,应用SPECT/CT(德国Siemens Symbia T16)行甲状旁腺显像。采用低能高分辨平行孔准直器,能峰140 keV,窗宽20%;2018年1月以前采用矩阵128×128、时间5 min,之后矩阵256×256、时间8 min,放大倍数2.67~3.20。延迟相结束后即行SPECT/CT采集,范围自颅底至心脏下缘,矩阵128×128,放大倍数1.0,采集32帧,16 s/帧,采集180°;CT扫描参数:电压130 kV,有效管电流90~110 mAs(CAREdose 4D技术),准直宽度16×1.2 mm,螺距1.2,重建层厚3 mm,卷积核B31 kernel,矩阵512×512。

甲状旁腺平面显像和SPECT图像原始数据经Syngo工作站(德国Siemens公司)重建生成轴位、矢状位和冠状位SPECT图像以及SPECT/CT融合图像。CT图像的窗宽、窗位设置为颈部软组织,在CT图像上观察甲状旁腺部位软组织密度结节并除外甲状腺结节,轴位、冠状位及矢状位SPECT/CT融合图像多角度观察显像剂浓聚为显像阳性(图1)。所得重建图像解读由2名经验丰富的核医学主治医师完成,记录该患者^{99m}Tc-MIBI SPECT/CT显像甲状旁腺数目。



A-D: Axial SPECT/CT demonstrate soft nodules with ^{99m}Tc-MIBI uptake at posterior of middle poles of both thyroid gland (white arrow indicates the right superior parathyroid, red arrow indicates the left superior parathyroid). E, F: Coronal SPECT/CT demonstrate soft tissue nodules with ^{99m}Tc-MIBI uptake at inferior to lower pole of the both thyroid gland (blue arrow indicates the right inferior parathyroid, yellow arrow indicates the left inferior parathyroid).

图1 肾性SHPT患者^{99m}Tc-MIBI SPECT/CT显像图

Figure 1 ^{99m}Tc-MIBI SPECT/CT of renal SHPT patient

1.3 统计学方法

采用SPSS 25.0软件对数据进行分析。符合正态分布的定量资料以均数±标准差($\bar{x} \pm s$)表示,两组间比较采用独立样本t检验,不符合正态分布的定

量资料以中位数(四分位数)[$M(P_{25}, P_{75})$]表示,两组间比较采用Wilcoxon秩和检验,分类变量采用 χ^2 检验或Fisher确切概率法。应用多因素Logistic回归分析HBS的独立影响因素,采用受试者工作特征

(receiver operating characteristic, ROC)曲线计算最佳截断值。 $P < 0.05$ 为差异有统计学意义。

2 结 果

2.1 一般情况

113例患者均顺利完成手术,术中共检出443枚甲状旁腺,病理显示甲状旁腺增生441枚,甲状旁腺腺瘤2枚。443枚甲状旁腺中^{99m}Tc-MIBI SPECT/CT检出390枚,SPECT/CT显像甲状旁腺≥4枚66例,SPECT/CT显像甲状旁腺<4枚47例。HBS的发生率

为55.8%(63/113)。HBS组中SPECT/CT显像甲状旁腺≥4枚者为47例(74.6%,47/63),非HBS组中SPECT/CT显像甲状旁腺≥4枚者为19例(38.0%,19/50)。

2.2 两组间临床、SPECT/CT显像甲状旁腺≥4枚及炎症指数的比较

HBS组与非HBS组的年龄、术前ALP、术前PTH、术前校正钙、SPECT/CT显像甲状旁腺≥4枚及PNI差异均有统计学意义($P=0.001, P<0.001, P=0.003, P=0.024, P<0.001, P=0.003$);而性别、透析龄、血钙、血磷、NLR、PLR、MLR及SII差异均无统计学意义(表1)。

表1 两组患者的临床资料、术前实验室指标、^{99m}Tc-MIBI SPECT/CT显像甲状旁腺≥4枚及外周血炎症指数比较
Table 1 The clinical indicators, preoperative laboratory parameters, the number of ^{99m}Tc-MIBI SPECT/CT parathyroid gland≥4, blood inflammatory index of the HBS group and non-HBS group

Characteristic	HBS group (n=63)	Non-HBS group (n=50)	P
Age (years, $\bar{x} \pm s$)	47.4 ± 10.8	54.1 ± 9.2	0.001
Sex (male/female, n/n)	40/23	23/27	0.063
Dialysis duration [min, $M(P_{25}, P_{75})$]	96 (72, 120)	84 (60, 120)	0.780
ALP [U/L, $M(P_{25}, P_{75})$]	322.70 (191.00, 636.10)	159.05 (122.85, 221.88)	< 0.001
PTH [pmol/L, $M(P_{25}, P_{75})$]	171.10 (114.00, 227.30)	120.95 (98.40, 163.18)	0.003
Serum calcium (mmol/L, $\bar{x} \pm s$)	2.47 ± 0.23	2.50 ± 0.19	0.444
Serum-corrected calcium [mmol/L, $M(P_{25}, P_{75})$]	2.43 (2.24, 2.53)	2.51 (2.39, 2.61)	0.024
Serum phosphorus (mmol/L, $\bar{x} \pm s$)	2.04 ± 0.43	2.08 ± 0.45	0.631
Parathyroid glands ≥4 detected by SPECT/CT* (n/n)	47/16	19/31	< 0.001
NLR [$M(P_{25}, P_{75})$]	2.86 (2.24, 3.87)	3.29 (2.23, 4.78)	0.361
PLR [$M(P_{25}, P_{75})$]	153.41 (110.53, 193.55)	161.64 (131.63, 189.03)	0.305
MLR [% , $M(P_{25}, P_{75})$]	29.33 (21.02, 37.96)	34.20 (23.39, 42.08)	0.202
SII [$\times 10^9/L, M(P_{25}, P_{75})$]	512.58 (324.68, 671.30)	492.34 (391.38, 674.00)	0.819
PNI [$M(P_{25}, P_{75})$]	49.95 (46.20, 52.00)	46.60 (43.74, 50.10)	0.003

a: the number of parathyroid glands ≥4 detected by ^{99m}Tc-MIBI SPECT/CT; ALP: alkaline phosphatase; PTH: parathyroid hormone; NLR: neutrophil to lymphocyte ratio; PLR: platelet to lymphocyte ratio; MLR: monocyte to lymphocyte ratio; SII: systemic immune inflammation index; PNI: prognostic nutritional index.

2.3 慢性肾脏病SHPT术后HBS的多因素Logistic回归分析

多因素Logistic回归分析示术前ALP(OR=1.005, 95%CI: 1.002~1.009, $P=0.002$), SPECT/CT显像甲状旁腺≥4枚(OR=3.166, 95%CI: 1.235~8.113, $P=0.016$)及PNI(OR=1.112, 95%CI: 1.013~1.221, $P=0.026$)为HBS的独立影响因素(表2)。

应用ROC曲线分析示术前ALP及PNI的最佳截断值为278.0 U/L和44.925。术前ALP≥278.0 U/L、SPECT/CT显像甲状旁腺≥4枚、PNI≥44.925及三者联合诊断HBS的灵敏度分别为63.5%、74.6%、82.5%及98.4%,差异有统计学意义($\chi^2=25.25, P < 0.001$),三者联合应用的灵敏度优于单独应用(Fisher确切概率法, $P < 0.001, P < 0.001, P=0.004$);诊断HBS

的特异度分别为86.0%、62.0%、44.0%及28.0%,差异有统计学意义($\chi^2=37.58, P < 0.001$);诊断HBS的准确性分别为73.5%、69.0%、65.5%及67.3%,差异无统计学意义($\chi^2=1.85, P=0.605$)。

3 讨 论

HBS为肾性SHPT行PTX术后较常见的并发症,表现为神经肌肉应激、肌肉痉挛等不良事件而延长住院时间及提高再入院率,严重者可导致喉肌和呼吸肌痉挛而危及生命^[1-2]。本研究中HBS的发生率为55.8%,与文献报道的27%~88%相符^[2, 6-7]。^{99m}Tc-MIBI SPECT/CT为肾性SHPT行PTX术前首选的影像学检查方法^[3-5];外周血炎症标志物具有临床易得、更具经济及可重复性佳等优势,提供患者炎

表2 113例肾性SHPT术后HBS的单因素及多因素Logistic回归分析

Table 2 Univariate and multivariate logistic regression analysis of HBS in 113 renal SHPT patients after PTX

Variable	Univariate analysis				Multivariate analysis			
	β	Wald χ^2	<i>P</i>	OR(95%CI)	β	Wald χ^2	<i>P</i>	OR(95%CI)
Age	-0.067	10.283	0.001	0.935(0.898-0.974)	-0.045	3.282	0.070	0.956(0.911-1.004)
Sex	0.714	3.419	0.064	2.042(0.985-4.350)	-	-	-	-
Dialysis duration	-0.002	0.152	0.697	0.998(0.990-1.007)	-	-	-	-
ALP	0.006	14.055	<0.001	1.006(1.003-1.010)	0.005	9.225	0.002	1.005(1.002-1.009)
PTH	0.009	9.045	0.003	1.009(1.003-1.016)	-	-	-	-
Serum calcium	-0.693	0.594	0.441	0.500(0.086-2.914)	-	-	-	-
Serum-corrected calcium	-2.134	5.078	0.024	0.118(0.018-0.757)	-	-	-	-
Serum phosphorus	-0.210	0.236	0.627	0.811(0.347-1.892)	-	-	-	-
Parathyroid glands $\geq$ 4(detected by SPECT/CT) ^a	1.567	14.560	<0.001	4.793(2.143-10.719)	1.152	5.759	0.016	3.166(1.235-8.113)
NLR	-0.091	0.519	0.471	0.913(0.713-1.169)	-	-	-	-
PLR	-0.004	1.495	0.221	0.996(0.990-1.002)	-	-	-	-
MLR	-0.016	1.396	0.237	0.984(0.958-1.011)	-	-	-	-
SII	0.000	0.309	0.578	1.000(0.999-1.001)	-	-	-	-
PNI	0.119	9.020	0.003	1.126(1.042-1.217)	0.106	4.932	0.026	1.112(1.013-1.221)

症负荷、营养及免疫更精确的表征,可作为临床医师判断透析患者预后简便而有效的工具^[12]。筛选临床常用的生物标志物、影像学及衍生参数,可识别HBS高危患者并早期干预,降低患者围手术期相关不良事件,减少患者的住院时长及费用。

肾性SHPT成功行PTX后PTH水平急剧下降,成骨细胞活性增强导致大量钙、磷快速沉积至骨骼,血钙快速且持续降低^[7],ALP为肾性骨营养不良的生物标志物,反映了骨转化状态、破骨细胞活性及骨吸收的程度^[13],有研究提示术前PTH及ALP水平为术后静脉补钙持续时间相关,表明术前PTH及ALP为HBS的独立影响因素^[14-16];而术前低钙血症可加重术后低钙程度,术前低钙血症也是术后HBS的独立影响因素^[7,13]。本研究中术前ALP为HBS独立影响因素,术前PTH及校正钙差异有统计学意义,但非独立影响因素,可能与纳入样本量少、各临床研究对HBS定义尚未完全统一及围手术期补钙管理不规范有关。PTX成功的关键在于切除所有病变甲状旁腺,术前影像学检出的甲状旁腺数量往往少于术中探查的数量,术前影像学检出甲状旁腺少于4枚,提示可能存在未病变的腺体或腺体较小难以被发现,或者存在异位和或额外的甲状旁腺在术中遗漏,术后发生严重低钙血症的风险下降^[17];邓兆燕等^[18]研究提示超声术前发现 $\geq$ 4枚甲状旁腺是消融治疗慢性肾脏病SHPT发生严重低钙血症的危险因素,与本研究中SPECT/CT显像甲状旁

腺 $\geq$ 4枚为HBS独立影响因素的结果相符。

本研究结果显示PNI为HBS的独立影响因素,两者间潜在关联的机制尚不明确。PNI为血清白蛋白占主导的复合指标,更全面地反映了患者的营养、系统性炎症和免疫状态^[8]。顾恒等^[19]的研究提示术前高血清白蛋白显著增加SHPT患者术后发生严重低钙血症的风险,可能为PNI是HBS独立影响因素的潜在交互机制;透析患者因日常活动受限、蛋白质摄入减少以及胃肠道吸收功能减退,患者的营养状况恶化,老年患者有更高的营养风险^[20],有研究表明PNI与年龄呈负相关^[21],低龄为SHPT患者术后HBS的独立影响因素^[2,7,13],可能为高PNI增加术后HBS风险的潜在关联机制。本研究中年龄为非独立影响因素,可能与纳入样本量少有关。应用ROC曲线分析术前ALP及PNI的最佳截断值为278.0 U/L、44.925,术前ALP $\geq$ 278.0 U/L、SPECT/CT显像甲状旁腺 $\geq$ 4枚及PNI $\geq$ 44.925三者联合诊断HBS的灵敏度为98.4%,优于单独应用,提示影像-临床多维度模式明显提高诊断HBS的灵敏度,为降低患者围手术期风险,维持钙磷代谢稳定,促进骨容量恢复提供了新思路。

综上所述,术前ALP、^{99m}Tc-MIBI SPECT/CT显像甲状旁腺 $\geq$ 4枚及PNI为肾性SHPT术后HBS的独立影响因素;术前ALP $\geq$ 278.0 U/L、^{99m}Tc-MIBI SPECT/CT显像甲状旁腺 $\geq$ 4枚及PNI $\geq$ 44.925三者联合模式提高了诊断术后HBS的灵敏度,精准定位病变甲状旁

腺的同时,践行个体化诊疗策略,降低肾性SHPT患者围手术期风险,具有良好的临床应用价值。本研究为单中心回顾性研究,入组病例数较少,相关结论需多中心、大样本量的进一步研究验证。

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CHNE Zejun was responsible for conducting the research, paper writing, and funding support; ZHOU Bin was responsible for data collection and analysis; HUANG Qianhuan, WU Chaoqun, and MENG Meng conducted the research and collected data; SHAO Qing provided research guidance and revised the paper.

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