doi: 10.13241/j.cnki.pmb.2018.19.021

微量元素五项联合红细胞四项检测在小儿缺铁性贫血中的诊断价值 *

李 娜 袁 晶 刘军辉 仝晓宁 张 楠

（西安交通大学第一附属医院检验科 陕西 西安 710061）

摘要 目的：探讨微量元素五项联合红细胞四项检测在小儿缺铁性贫血(IDA)中的诊断价值。**方法**：选取 2013 年 1 月至 2016 年 1 月于我院进行治疗的小儿缺铁性贫血(IDA)患儿 130 例作为缺铁性贫血(IDA)组及同期于我院进行常规体检的健康儿童 40 例作为对照组。检测和比较其钙、镁、铜、铁、锌、血红蛋白(Hb)、平均红细胞体积(MCV)、平均血红蛋白含量(MCH)、平均血红蛋白浓度(MCHC)水平，并比较微量元素五项、红细胞四项检查以及两者联合对 IDA 患儿的诊断效能。**结果**：缺铁性贫血(IDA)组患儿微量元素镁、铁、锌含量以及 Hb、MCV、MCH 及 MCHC 水平均明显低于对照组儿童，差异具有统计学意义(P<0.05)；两组儿童微量元素钙、铜含量比较差异不显著(P>0.05)。微量元素五项联合红细胞四项的灵敏度、特异度、阳性预测值及阴性预测值均明显高于微量元素五项和红细胞四项(P<0.05)。**结论**：IDA 患儿微量元素镁、铁、锌含量以及 Hb、MCV、MCH 及 MCHC 水平较低，微量元素五项联合红细胞四项检测可以提高小儿 IDA 的检出率。

关键词：缺铁性贫血；微量元素五项；红细胞四项；诊断价值

中图分类号：R556.3；R725.5 **文献标识码**：A **文章编号**：1673-6273(2018)19-3694-04

Clinical Value of Five Trace Elements Combined with RBC Four Parameters Detection in Diagnosis of Children with IDA*

LI Na, YUAN Jing, LIU Jun-hui, TONG Xiao-ning, ZHANG Nan

(Clinical Laboratory Department, The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, Shaanxi, 710061, China)

ABSTRACT Objective: To explore the five trace elements and red blood cells (RBC) four parameters in diagnosis of children with iron deficiency anemia (IDA). **Methods:** Children with (130 cases) accepted in our hospital for treatment and 40 healthy children underwent physical exam from Jan, 2013 to Jan, 2016 were selected in this study. The expression level of five trace elements (Ca, Mg, Cu, Fe and Zn) and four RBC parameters (Hb, MCV, MCH and MCHC) were retrospectively analyzed. The positive prediction of five trace elements, RBC four parameters and the combination detection for 130 children with IDA was compared. **Results:** The expression level of Mg, Fe, Zn, Hb, MCV, MCH and MCHC of children with IDA were significantly lower than that of control group (P<0.05), but the differences between the expression level of Ca and Cu of two groups had no significant significance (P>0.05); The sensitivity, specificity, positive predictive value and negative predictive value of the five combinations of micronutrients were significantly higher than that of micronutrients and erythrocytes (P<0.05). **Conclusion:** The expression level of Mg, Fe, Zn, Hb, MCV, MCH and MCHC of children with IDA were significantly lower than that of control group. Timely supplementation of trace elements magnesium, iron and zinc are important measures to prevent iron deficiency anemia (IDA). Five trace elements combined with RBC four parameters detection can improve the predictive rate of children with IDA and has important diagnostic value.

Key words: Iron deficiency anemia; Five trace elements; RBC four parameters; Diagnostic value

Chinese Library Classification(CLC): R556.3; R725.5 Document code: A

Article ID: 1673-6273(2018)19-3694-04

前言

缺铁性贫血(IDA)是一种常发生于婴幼儿时期的小儿营养缺乏症，在发展中国家的发病率较高。我国小儿 IDA 好发于 6 个月 ~3 岁婴幼儿，发病率可高达 25%以上[1,2]。该疾病可危害小儿神经系统，造成患儿反应低下、精神不能集中、记忆力差等，对儿童健康成长造成较大威胁[3-5]。近年来，缺铁已不再是影响小儿贫血患病率的主要因素，而体内铜、锌、钙等微量元素的平衡失调确缺乏对小儿贫血患病率的影响较大。儿童体内缺铜时，易导致患儿体内铜蓝蛋白含量降低，进而影响机体铁的吸收、储存，导致其发生低色素性贫血；儿童缺锌易导致儿童出现厌食、消瘦、腹泻等临床症状，同时，腹泻反过来又加重儿童机体微量元素锌的含量，此循环易使儿童出现营养性 IDA[6-8]。因此，为预防儿童发生 IDA，对微量元素进行及时、有效的检测显得尤为重要。

IDA 的诊断一般以微量元素检测及红细胞检测为主要筛

* 基金项目：陕西省社会发展科技攻关项目(2015SF057)

作者简介：李娜(1982-)，女，硕士研究生，主管检验师，研究方向：临床检验诊断及妇幼健康研究，E-mail: lina_1982@papmedline.cn

(收稿日期：2018-03-04 接受日期：2018-03-28)

查方式[9-11]。本研究对近年来我院收治的 IDA 患儿微量元素五项及红细胞四项检测结果进行回顾性分析，旨在明确上述两种检测方式联合对小儿 IDA 的诊断价值，为临床诊断提供参考依据，现报道如下。

1 资料与方法

1.1 一般资料

收取 2013 年 1 月至 2016 年 1 月于我院进行治疗的 IDA 患儿 130 例作为研究对象，纳入及排除标准为：(1)所有患儿均符合《血液病诊断及疗效标准》中 IDA 的诊断标准[4]；(2)于我院进行微量元素五项及红细胞四项检测，具有完整的检测结果及病历资料；(3)年龄≤ 6 岁；(4)排除合并其他系统严重疾病患儿。130 例患儿中，男性 78 例(60.00%)，女性 52 例(40.00%)；年龄 <1 岁者 25 例(19.23%)，年龄 1~3 岁者 52 例(40.00%)，年龄 >3 岁者 53 例(40.77%)；轻度贫血 81 例(62.31%)，中度贫血 32 例(24.62%)，重度及极重度贫血 17 例(13.08%)。选择同期于我院进行常规体检的年龄≤ 6 岁的健康儿童 40 例作为对照组，对照组儿童均经过微量元素五项及红细胞四项检测，且结果均处于正常范围。对照组儿童中男性 25 例 (62.50%)，女性 15 例 (37.50%)；年龄 <1 岁者 8 例 (20.00%)，年龄 1~3 岁者 15 例 (37.50%)，年龄 >3 岁者 17 例(42.50%)。两组基础资料比较差异均无统计学意义(P>0.05)，具有可比性。

1.2 检测方法

于检测当日清晨抽取患儿或体检儿童空腹静脉血 2 mL 进行检测。微量元素五项检测所用仪器为北京博晖创新光电技术有限公司生产的 BH5300S、BH5500S 型原子吸收光谱仪，所用试剂为仪器配套人体元素专用检测试剂，所用方法为原子吸收光谱法。检测项目包括钙、镁、铜、铁、锌五项。Hb、MCV、MCH 和 MCHC 红细胞四项检测所用仪器为希斯美康公司生产的 Sysmex XE-2100 全自动血液分析仪，所用试剂为仪器配套试剂盒。上述操作均严格按照仪器说明及操作规程进行。

1.3 观察指标

(1)对比两组儿童微量元素五项镁、铁、锌、钙、铜的检测结果；(2)对比两组儿童红细胞四项 Hb、MCV、MCH 及 MCHC 的检查结果；(3) 分别以对照组的微量元素五项和红细胞四项水平作为诊断临界值，计算微量元素五项、红细胞四项检测以及两者联合检测的灵敏度、特异度、阳性预测值及阴性预测值，其中，两者联合检查的阳性标准是微量元素五项或红细胞四项检查为阳性。

1.4 统计学方法

采用 SPSS 18.0 软件，计量资料以(均数± 标准差)形式表示，组间对比经独立样本 t 检验；计数资料以%形式表示，组间对比经卡方检验。以 P＜0.05 为差异存在统计学意义。

2 结果

2.1 两组儿童微量元素五项检测结果比较

IDA 组患儿微量元素镁、铁、锌含量均明显低于对照组儿童，差异具有统计学意义(P<0.05)，两组儿童微量元素钙、铜含量比较差异不显著(P>0.05)，见表 1。

表 1 两组儿童微量元素五项检测结果比较($\bar{x}$± s)

Table 1 Comparisons of the test results of five trace elements between two groups($\bar{x}$± s)

Group	n	Ca(mmol/L)	Mg(mmol/L)	Cu(μmol/L)	Fe(mmol/L)	Zn(μmol/L)
IDA group	130	1.88± 0.12	1.11± 0.09*	21.62± 6.13	5.64± 0.24*	60.91± 3.68*
Control group	40	1.89± 0.10	1.78± 0.12	23.08± 7.91	7.95± 0.41	84.47± 3.42
P		0.955	0.047	0.442	0.046	0.043

2.2 两组儿童红细胞四项检测结果比较

IDA 组患儿 Hb、MCV、MCH 及 MCHC 均低于对照组儿童(P<0.05)，见表 2。

表 2 两组儿童红细胞四项检测结果比较($\bar{x}$± s)

Table 2 Comparisons of the test results of four RBC parameters between two groups($\bar{x}$± s)

Group	n	Hb(g/L)	MCV(fL)	MCH(pg)	MCHC(g/L)
IDA group	130	102.00± 3.10	62.36± 2.94	20.22± 2.08	248.00± 13.26
Control group	40	135.00± 5.31	85.07± 3.93	33.46± 2.10	342.00± 16.37
P		0.033	0.044	0.046	0.040

2.3 微量元素五项、红细胞四项检查以及两者联合的诊断效能比较

结果显示，微量元素五项与红细胞四项联合检测的灵敏度、特异度、阳性预测值及阴性预测值均明显高于单项检测(P<0.05)，如表 3。

3 讨论

小儿 IDA 是一种较为常见的儿童疾病，好发于 6 个月至 3 岁儿童，致就诊时多数病儿已为中度贫血。发病原因主要包括铁摄入量不足、吸收量减少、需要量增加、铁利用障碍或丢失过多所致，由于贫血患儿体内铁缺乏，致使血红蛋白合成减少，进而使患儿产生小细胞低色素性贫血[12-14]。IDA 以皮肤黏膜苍白、表情淡漠、倦怠乏力、食欲不振等为主要临床表现，可导致患儿免疫力低下或发育迟缓，严重者甚至可能影响智力发育[15,16]。有

研究报道显示，生命早期的 IDA 可能对患儿智力发育造成不可逆转的影响[17-19]。由于该病大多起病较缓慢，初期临床表现不明显，就诊时多数患儿已发展为中度贫血。因此，对 IDA 患儿进行准确诊断及治疗具有重要的临床意义。

表 3 微量元素五项、红细胞四项检查以及两者联合的诊断效能比较

Table 3 Comparisons of diagnosis effect of five trace elements、four RBC parameters and the two combined

Test method	Sensitivity(%)	Specificity(%)	Positive prediction(%)	Negative prediction(%)
Trace elements	70.21	72.22	86.84	48.15
RBC fourparameters	76.47	75.00	91.76	53.33
Two combined	98.36	87.50	99.17	77.78

目前，诊断 IDA 的方法中[20-22]，外周血常规检查的灵敏度不高，铁代谢参数又易受多种因素影响，而骨髓小粒铁染色作为临床诊断铁缺乏的金标准，骨髓穿刺时损伤性较大、耗时，患者依从性较差，均不能完全满足临床需要[23-25]。因此，寻求一种更为有效和便捷的 IDA 诊断方法尤为重要。

本研究回顾分析了健康儿童和 IDA 患儿的微量元素五项及红细胞四项检测结果，并比较微量元素五项、红细胞四项检查以及两者联合对 IDA 患儿的诊断效能。结果显示，与健康儿童比较，IDA 患儿除血清铁含量下降外，血清镁、锌的含量也明显低于健康儿童。IDA 患儿 Hb、MCV、MCH 及 MCHC 均明显低于健康儿童；分别以健康儿童的微量元素五项和红细胞四项水平作为诊断临界值，比较微量元素五项、红细胞四项检测以及两者联合对 130 例 IDA 患儿的诊断效能，微量元素五项联合红细胞四项检测的灵敏度、特异度、阳性预测值及阴性预测值均明显高于单项检测法($P<0.05$)。表明，将两者联合用于诊断 IDA 患儿的准确率较高，可有效减少单一检查的漏诊率，通过全面、准确地对 IDA 患儿进行诊断，可及时、有效地对治疗方案进行调整，临床实用价值较高。范芳等研究报道显示，IDA 患儿微量元素铁、锌含量均明显降低，与本研究报道相似[26,27]。该研究指出，锌缺乏可导致铁蛋白合成减少，影响铁转运，并且会造成味觉功能减退，导致患儿摄食减少，IDA 加重。李培培等研究结果显示，IDA 患儿铁元素与镁元素均降低，并指出酶可影响血红蛋白合成及红细胞稳定性，且与铁元素存在一定的协同作用，故铁元素缺乏也可造成镁元素吸收障碍[28-30]。可见，微量元素的缺乏或失衡与 IDA 密切相关，值得关注。

综上所述，微量元素镁、铁、锌含量以及 Hb、MCV、MCH 及 MCHC 水平在缺铁性贫血(IDA)患儿体内较低，及时补充微量元素镁、铁、锌是预防缺铁性贫血(IDA)的重要举措。微量元素五项联合红细胞四项检测可以提高小儿 IDA 的诊断效能，可为临床诊断小儿缺血性贫血提供更多的参考。

参 考 文 献(References)

[1] Kandhro AH, Prachayasittikul V, Isarankura Na-Ayudhya C, et al. Prevalence of Thalassemia Traits and Iron Deficiency Anemia in Sindh, Pakistan[J]. Hemoglobin, 2017, 41(3): 157-163

[2] Ford DC, Dahl NV, Strauss WE, et al. Ferumoxytol versus placebo in iron deficiency anemia: efficacy, safety, and quality of life in patients with gastrointestinal disorders [J]. Clin Exp Gastroenterol, 2016, 11 (9): 151-162

[3] Matos JF, Dusse LM, Borges KB, et al. A new index to discriminate between iron deficiency anemia and thalassemia trait [J]. Rev Bras Hematol Hemoter, 2016, 38(3): 214-219

[4] Okuturlar Y, Gedikbasi A, Akalin N, et al. Serum paraoxonase 1 activity in patients with iron deficiency anemia[J]. Arch Med Sci, 2016, 12 (4): 697-703

[5] Kubilay P, Doganay B, Bektas M. Evaluation of Esophageal Functions by Manometry in Iron Deficiency Anemia Patients[J]. Gastroenterology Res, 2017, 10(3): 166-171

[6] Low MS, Grigoriadis G. Iron deficiency and new insights into therapy [J]. Med J Aust, 2017, 207(2): 81-87

[7] Kara GT, Kara M, Bayram A, et al. Assessment of seasonal and spatial variations of physicochemical parameters and trace elements along a heavily polluted effluent-dominated stream[J]. Environ Monit Assess, 2017, 189(11): 585

[8] Demenko V, Linetskiy I, Linetska L, et al. Prognosis of implant longevity in terms of annual bone loss: a methodological finite element study [J]. Comput Methods Biomech Biomed Engin, 2016, 19 (2): 180-187

[9] Kurzawa T, Owczarek A, Strzelczyk JK, et al. The Content of Reticulocyte Hemoglobin and Serum Concentration of the Soluble Transferrin Receptor for Diagnostics of Anemia in Chronically Hemodialyzed Patients[J]. Adv Clin Exp Med, 2016, 25(3): 425-431

[10] Abu Hashim H, Foda O, Ghayaty E. Lactoferrin or ferrous salts for iron deficiency anemia in pregnancy: A meta-analysis of randomized trials[J]. Eur J Obstet Gynecol Reprod Biol, 2017, 21(9): 45-52

[11] Musallam KM, Taher AT. Iron deficiency beyond erythropoiesis: should we be concerned?[J]. Curr Med Res Opin, 2017, 3(1): 1-13

[12] Zheng S, Wang B, Li Y, et al. Electrochemically active iron (III)-reducing bacteria in coastal riverine sediments [J]. J Basic Microbiol, 2017, 57(12): 1045-1054

[13] Nguyen LT, Buse JD, Baskin L, et al. Influence of diurnal variation and fasting on serum iron concentrations in a community-based population[J]. Clin Biochem, 2017, 50(18): 1237-1242

[14] Nehra P, Chauhan RP, Garg N, et al. Antibacterial and antifungal activity of chitosan coated iron oxide nanoparticles[J]. Br J Biomed Sci, 2017, 25(1): 1-6

[15] Fujita T. Effect of Different Iron Preparations for Young Children With Iron-Deficiency Anemia[J]. JAMA, 2017, 318(13): 1282

[16] Kumari R, Bharti RK, Singh K. Prevalence of Iron Deficiency and Iron Deficiency Anaemia in Adolescent Girls in a Tertiary Care Hospital[J]. J Clin Diagn Res, 2017, 11(8): BC04-BC06

[17] Liberti ME, Garofalo C, Sagliocca A, et al. Iron deficiency in ND-CKD: from diagnosis to treatment [J]. G Ital Nefrol, 2017, 34(5):

50-61

[18] Suzuki T. Iron deficiency anemia refractory to iron preparations[J]. Rinsho Ketsueki, 2016, 57(10): 1881-1889

[19] Kassir A. Iron deficiency: A diagnostic and therapeutic perspective in psychiatry[J]. Encephale, 2017, 43(1): 85-89

[20] DeLoughery TG. Iron Deficiency Anemia [J]. Med Clin North Am, 2017, 101(2): 319-332

[21] Akpınar H, Çetiner M, Keshav S, et al. Diagnosis and treatment of iron deficiency anemia in patients with inflammatory bowel disease and gastrointestinal bleeding: iron deficiency anemia working group consensus report[J]. Turk J Gastroenterol, 2017, 28(2): 81-87

[22] Lucendo AJ, Arias Á, Roncero Ó, et al. Anemia at the time of diagnosis of inflammatory bowel disease: Prevalence and associated factors in adolescent and adult patients[J]. Dig Liver Dis, 2017, 49(4): 405-411

[23] Mücke VMücke MM, Raine T, et al. Diagnosis and treatment of anemia in patients with inflammatory bowel disease [J]. Ann Gastroenterol, 2017, 30(1): 15-22

[24] Percy L, Mansour D, Fraser I, et al. Iron deficiency and iron deficiency anaemia in women[J]. Best Pract Res Clin Obstet Gynaecol, 2017, 40 (1): 55-67

[25] Powers JM, Shamoun M, McCavit TL. Intravenous Ferric Carboxymaltose in Children with Iron Deficiency Anemia Who Respond Poorly to Oral Iron[J]. J Pediatr, 2017, 180(1): 212-216

[26] Cui J, Li Y, Yu P, et al. A novel low molecular weight Enteromorpha polysaccharide-iron (III) complex and its effect on rats with iron deficiency anemia (IDA)[J]. Int J Biol Macromol, 2017, 10(6): 412-418

[27] Anoshkina Y, Costas-Rodríguez M, Speeckaert M, et al. Iron isotopic composition of blood serum in anemia of chronic kidney disease[J]. Metallomics, 2017, 9(5): 517-524

[28] Bjørklund G, Aaseth J, Skalny AV. Interactions of iron with manganese, zinc, chromium, and selenium as related to prophylaxis and treatment of iron deficiency [J]. J Trace Elem Med Biol, 2017, 41(1): 41-53

[29] Büyükkaragöz B, Akgun NA, Bulus AD, et al. Can soluble transferrin receptor be used in diagnosing iron deficiency anemia and assessing iron response in infants with moderate acute malnutrition?[J]. Arch Argent Pediatr, 2017, 115(2): 125-132

[30] Nielsen P, Kongi R, Fischer R. Efficacy of an iron retard preparation in patients with iron deficiency anemia [J]. MMW Fortschr Med, 2016, 158(6): 17-23

(上接第 3636 页)

[12] Thu VT, Kim HK, Han J. Acute and Chronic Exercise in Animal Models[J]. Adv Exp Med Biol, 2017, 999: 55-71

[13] Gu Q, Zhao L, Ma YP, et al. Contribution of mitochondrial function to exercise-induced attenuation of renal dysfunction in spontaneously hypertensive rats[J]. Mol Cell Biochem, 2015, 406(1-2): 217-225

[14] Nair AR, Ebenezer PJ, Saini Y, Francis J. Angiotensin II-induced hypertensive renal inflammation is mediated through HMGB1-TLR4 signaling in rat tubulo-epithelial cells[J]. Exp Cell Res, 2015, 335(2): 238-247

[15] Masson GS, Nair AR, Silva SPP, et al. Aerobic training normalizes autonomic dysfunction, HMGB1 content, microglia activation and inflammation in hypothalamic paraventricular nucleus of SHR[J]. Am J Physiol Heart Circ Physiol, 2015, 309(7): H1115-1122

[16] Liu T, Zhang DY, Zhou YH, et al. Increased serum HMGB1 level may predict the fatal outcomes in patients with chronic heart failure [J]. Int J Cardiol, 2015, 184: 318-320

[17] He L, Sun F, Wang Y, et al. HMGB1 exacerbates bronchiolitis obliterans syndrome via RAGE/NF-κB/HPSE signaling to enhance latent TGF-β release from ECM [J]. Am J Transl Res, 2016, 8 (5): 1971-1984

[18] Wang WK, Wang B, Lu QH, et al. Inhibition of high-mobility group box 1 improves myocardial fibrosis and dysfunction in diabetic cardiomyopathy[J]. Int J Cardiol, 2014, 172(1): 202-212

[19] Ma YG, Zhang XW, Bao HY, et al. Blocking extracellular HMGB1 activity protects against doxorubicin induced cardiac injury in mice [J]. Yao Xue Xue Bao, 2012, 47(11): 1489-1495

[20] Matsuda S, Umemoto S, Yoshimura K, et al. Angiotensin Ⅱ Activates MCP-1 and Induces Cardiac Hypertrophy and Dysfunction via Toll-like Receptor 4[J]. J Atheroscler Thromb, 2015, 22(8): 833-844

[21] Giallauria F, Cirillo P, D'agostino M, et al. Effects of exercise training on high-mobility group box-1 levels after acute myocardial infarction [J]. J Card Fail, 2011, 17(2): 108-114

[22] Robinson E, Durrer C, Simtchouk S, et al. Short-term high-intensity interval and moderate-intensity continuous training reduce leukocyte TLR4 in inactive adults at elevated risk of type 2 diabetes [J]. J Appl Physiol (1985), 2015, 119(5): 508-516