·论著·

血清AMH及性激素水平与大学生体检多囊卵巢综合征的相关性*

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【摘要】**目的** 分析血清抗缪勒氏管激素(AMH)及性激素水平与大学生体检多囊卵巢综合征(PCOS)的相关性。**方法** 收集2021年3月-2023年11月我院体检确诊为PCOS的80例大学生临床资料作为观察组，另外收集同时期体检的128例非PCOS人群临床资料为对照组。比较两组一般资料、AMH及性激素水平；受试者操作特征曲线(ROC)下面积(AUC)评价AMH及性激素6项对PCOS的预测效能；皮尔森相关性分析AMH水平与性激素水平的相关关系。**结果** 两组年龄、身高、体重、体质量指数比较差异无统计学意义(*P*>0.05)。PCOS组促卵泡生成素、促黄体生成素、雌二醇、睾酮、催乳素均高于非PCOS组，孕酮低于非PCOS组，差异显著，*P*<0.05。将PCOS=1，非PCOS=0作为因变量，AMH、性激素6项作为自变量，进行ROC曲线分析，结果显示，AMH及性激素6项均对PCOS有良好的预测价值，AUC分别为0.946、0.924，灵敏度分别为0.850、0.850，特异度为0.977、0.891。但AMH联合性激素6项的预测效能较高，AUC最大，为0.997，灵敏度为0.988，特异度为0.977。AMH的预测阈值为7.975ng/mL。PCOS患者血清AMH水平与促黄体生成素、雌二醇呈显著正相关关系(*P*<0.05)，与促卵泡生成素、睾酮、孕酮、催乳素的相关关系不显著(*P*>0.05)。**结论** AMH及性激素水平在大学生体检确认为PCOS血清中异常表达，血清AMH及性激素水平可能与PCOS具有一定相关性，AMH联合性激素6项目对PCOS有良好的评估价值，AMH与促黄体生成素、雌二醇呈显著正相关关系。

【关键词】AMH；促卵泡生成素；促黄体生成素；雌二醇；孕酮；睾酮；催乳素；多囊卵巢综合征
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Correlation between Serum AMH and Sex Hormone Levels and Polycystic Ovary Syndrome in College Students*

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Abstract: ***Objective*** To analyze the correlation between serum levels of anti-Muller's hormone (AMH) and sex hormone and polycystic ovary syndrome (PCOS). ***Methods*** The clinical data of 80 college students diagnosed with PCOS during physical examination in our hospital from March 2021 to November 2023 were collected as the observation group, and the clinical data of 128 non-PCOS patients during physical examination during the same period were collected as the control group. General data, AMH and sex hormone levels were compared between the two groups. The area under receiver operating characteristic curve (ROC) (AUC) was used to evaluate the predictive efficacy of AMH and sex hormones in PCOS. The correlation between AMH level and sex hormone level was analyzed by Pearson correlation. ***Results*** There were no significant differences in age, height, weight and body mass index between the two groups (*P*>0.05). Follicle-stimulating hormone, luteinizing hormone, estradiol, testosterone and prolactin in PCOS group were higher than those in non-PCOS group, and progesterone was lower than that in non-PCOS group, the difference was significant (*P*<0.05). With PCOS=1, non-PCOS =0 as dependent variables, and AMH and sex hormone as independent variables, ROC curve analysis was performed. The results showed that AMH and sex hormone had good predictive value for PCOS, with AUC of 0.946 and 0.924 and sensitivity of 0.850 and 0.850, respectively. The specificity was 0.977 and 0.891. However, AMH combined with sex hormone 6 had higher predictive efficacy, with the largest AUC (0.997), sensitivity (0.988) and specificity (0.977). The predicted threshold of AMH was 7.975 ng/mL. Serum AMH level in PCOS patients was significantly positively correlated with luteinizing hormone and estradiol (*P*<0.05), but was not significantly correlated with follicle-stimulating hormone, testosterone, progesterone and prolactin (*P*>0.05). ***Conclusion*** The abnormal expression of AMH and sex hormone levels in serum of PCOS was confirmed by physical examination of college students, and the serum AMH and sex hormone levels may have a certain correlation with PCOS. AMH combined with sex hormone 6 has a good evaluation value for PCOS, and AMH has a significant positive correlation with luteinizing hormone and estradiol.

Keywords: AMH; Follicle-stimulating Hormone; Luteinizing Hormone; Estradiol; Progesterone; Testosterone; Prolactin; Polycystic Ovary Syndrome

多囊卵巢综合征(polycystic ovary syndrome，PCOS)是最普遍的代谢和内分泌疾病，其影响着全球约五分之一的育龄女性[1-2]。PCOS的发生与卵巢功能、雄激素水平异常等相关[3-4]。既往研究显示，促卵泡生成素、促黄体生成素、雌二醇、孕酮、睾酮、催乳素等性激素六项水平异常可能与PCOS有关，但其确切的发病机制尚未全面阐明[5]。抗缪勒氏管激素(anti-mullerian hormone，AMH)是窦前卵泡和小窦卵泡的颗粒细胞分泌的糖蛋白。窦卵泡计数与血清中AMH的含量成正比，窦卵泡计数越多，血清AMH含量越高。AMH具有抑制原始卵泡招募的作用，在主导卵泡的筛选中发挥重要作用[6]。AMH水平可以稳定地响应原始卵泡池中的卵泡数量。其对于评价卵巢储备功能有重要作用。与健康女性相比，PCOS患者血清AMH水平较高，较高的AMH水平可能与月经失调和排卵障碍有关[7]。目前，PCOS的具体机制尚不明确，本文着重分析血清AMH及性激素水平与大学生体检PCOS的关系，为大学生体检中PCOS的早期诊断提供依据。

1 资料与方法

1.1 一般资料　收集2021年3月-2023年11月我院体检确诊为PCOS的80例大学生临床资料作为观察组，另外收集同时期体检的128例非PCOS人群临床资料为对照组。

PCOS纳入标准：确认为PCOS[8]；均实施血清AMH及性激素水平的测定。排除标准：先天性肾上腺增生症；甲状腺疾病；

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高泌乳素血症；雄激素分泌性肿瘤；库欣综合征；三个月内服用避孕药者；既往卵巢切除术者。非PCOS纳入标准：均实施血清AMH及性激素水平的测定。排除标准同PCOS。

1.2 方法

1.2.1 血清AMH及性激素水平的测定 采集所有受试者静脉血，提取血清备用，依照贝克曼购买的AMH试剂盒说明书详细操作测定血清AMH含量。采用安图生物购买的全自动化学发光测定仪测定性激素六项促卵泡生成素、促黄体生成素、雌二醇、孕酮、睾酮以及催乳素水平。

1.3 统计学方法 以SPSS 24.00分析本次数据，年龄、身高、体重、体质量指数、AMH、促卵泡生成素、促黄体生成素、雌二醇、孕酮、睾酮、催乳素等计量数据以($\bar{x}\pm s$)描述，t检验，受试者操作特征曲线(receiver operating characteristic curve，ROC)下面积(area under curve，AUC)评价AMH及性激素6项对PCOS的预测效能，皮尔森相关性分析AMH与性激素6项的相关关系，$P<0.05$为差异有统计学意义。

2 结 果

2.1 2组一般资料比较 两组年龄、身高、体重、体质量指数比较差异无统计学意义($P>0.05$)。PCOS组促卵泡生成素、促黄体生成素、雌二醇、睾酮、催乳素均高于非PCOS组，孕酮低于非PCOS组，差异显著，$P<0.05$。见表1。

2.2 血清AMH及性激素水平对大学生体检PCOS的预测价值 将PCOS=1，非PCOS=0作为因变量，AMH、性激素6项作为自变量，进行ROC曲线分析，结果显示，AMH及性激素6项均对PCOS有良好的预测价值，AUC分别为0.946、0.924，灵敏度分别为0.850、0.850，特异度为0.977、0.891。但AMH联合性激素6项的预测效能较高，AUC最大，为0.997，灵敏度为0.988，特异度为0.977。AMH的预测阈值为7.975 ng/mL。见表2、图1。

2.3 PCOS患者血清AMH与性激素水平的相关性 PCOS患者血清AMH水平与促黄体生成素、雌二醇呈显著正相关关系($P<0.05$)，与促卵泡生成素、睾酮、孕酮、催乳素的相关关系不显著($P>0.05$)。见表3。

表1 2组基本资料比较[n(%)]

项目	PCOS组(n=80例)	非PCOS组(n=128例)	t/c2	P
年龄(岁)	20.10±1.02	19.85±1.15	1.592	0.113
身高(cm)	161.88±5.62	161.24±5.41	0.818	0.415
体重(kg)	51.71±4.35	52.45±4.66	1.143	0.255
体质量指数(kg/m2)	21.32±1.06	21.19±1.11	0.836	0.404
AMH(ng/mL)	11.13±3.31	5.64±1.14	17.178	0.000
促卵泡生成素(IU/L)	6.26±1.08	5.32±1.11	6.004	0.000
促黄体生成素(U/L)	10.34±2.35	8.77±1.57	5.776	0.000
雌二醇(pmol/L)	123.26±50.21	101.65±42.32	3.332	0.001
孕酮(ng/mL)	4.11±1.11	4.49±1.15	2.350	0.020
睾酮(nmol/L)	2.11±0.62	1.32±0.34	11.853	0.000
催乳素(ng/mL)	15.23±3.85	12.41±3.65	5.308	0.000

表2 血清AMH及性激素水平对大学生体检PCOS的预测价值

指标	约登指数	临界值	AUC	P	AUC的95%置信区间	灵敏度	特异度
AMH	0.827	7.975	0.946	0.000	0.906-0.906	0.850	0.977
性激素6项	-	-	0.924	0.000	0.884-0.884	0.850	0.891
AMH联合性激素6项	-	-	0.997	0.000	0.993-1.000	0.988	0.977

表3 PCOS患者血清AMH与性激素水平的相关性

指标		促卵泡生成素	促黄体生成素	雌二醇	睾酮	孕酮	催乳素
AMH	r	0.234	0.525	0.571	0.178	-0.192	0.188
	P	>0.05	<0.05	<0.001	>0.05	>0.05	>0.05

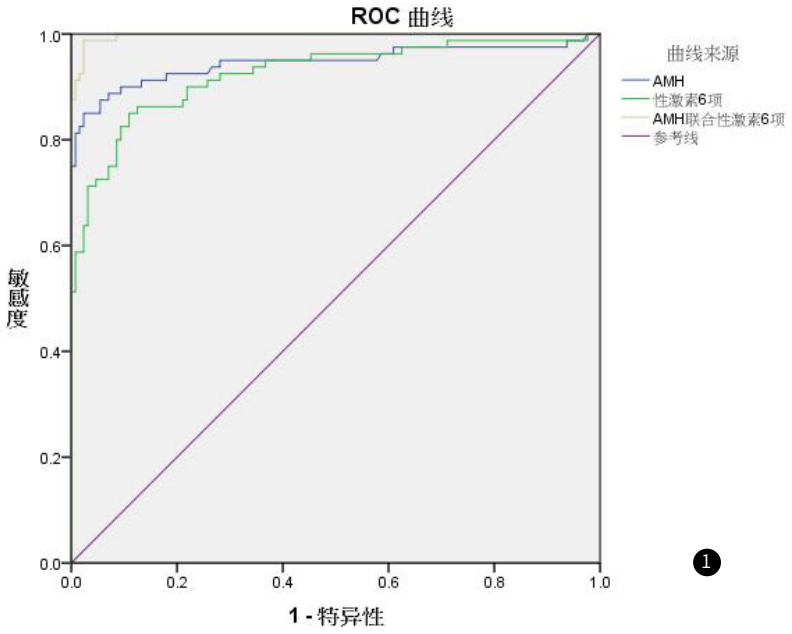

图1 血清AMH及性激素水平对大学生体检PCOS的预测价值

3 讨 论

目前，PCOS发病率呈升高趋势。其发生涉及主观遗传改变、炎症反应、氧化应激、高雄激素、肥胖等，并与环境、压力、饮食等相关[9-11]。随着各种医学手段的更新和迭代，该疾病的诊断准确性也逐步提升[12]。既往有研究显示，AMH的联合检测可增加PCOS的诊出率[13-14]。本文对AMH及性激素水平与PCOS的相关性进行分析，以早期发现及治疗PCOS。

既往研究显示，促黄体生成素的异常增加是PCOS常见现象[15]。这主要与该疾病出现的卵泡发育异常及高雄激素水平相关。促黄体生成素/绒毛膜促性腺激素受体(chorionic gonadotropin receptor，CGR)参与卵泡膜细胞中类固醇的生成。促黄体生成素与CGR的异常均可能影响类固醇的生成，并可能影响睾酮的分泌，从而减少睾酮向雌二醇的转化，引起PCOS的发生[16-18]。PCOS患者雄性激素及促黄体生成素异常分泌，卵巢颗粒增殖异常，促进促卵泡生成素的生成，且孕酮呈降低趋势，催乳素水平升高[19-20]。本研究结果显示，大学生体检确认为PCOS患者血清中AMH及性激素水平均异常表达，PCOS组促卵泡生成素、雌二醇、促黄体生成素、睾酮、催乳素均显著高于非PCOS组，孕酮显著低于非PCOS组。这与上述结论相符。既往已有多项研究证实了，性激素6项在PCOS评估中的实用价值[21-22]。促黄体生成素、雌二醇的异常变化还可能与疾病严重程度有关。本研究结果显示，AMH联合性激素6项目对PCOS有良好的评估价值，AMH与促黄体生成素、雌二醇呈显著正相关关系。周凤华等人研究也显示，PCOS患者血清AMH水平与性激素水平存在相关关系[23]。这与本研究结果一致。AMH可通过抑制促卵泡生成素的合成，抑制芳香化酶的活性，从而抑制了卵泡的发育。同时，AMH还可能促进机体分泌大量的促黄体生成素，导致PCOS患者血清中促黄体生成素含量增加[24]。促黄体生成素的异常增加可能通过促进雄激素的释放，引起卵泡发育停滞，促卵泡生成素大量释放入血清中。这也提示AMH可能与促黄体生成素水平存在相关关系。PCOS患者血清AMH含量的增加可能引起卵泡募集过多，从而抑制卵泡发育，小窦状卵泡数量增加，从而增强雌激素的分泌作用。同时，促黄体生成素的大量生成可能促进雄激素的产生，二者发挥协同作用，共同促进雄烯二酮的生成，转化的雌酮增多，从而引起雌二醇、雌酮表达水平的异常增加[25]。这也提示AMH与雌二醇具有一定相关性。

综上所述，AMH及性激素水平在大学生体检确认为PCOS血清中异常表达，血清AMH及性激素水平可能与PCOS具有一定相关性，AMH联合性激素6项目对PCOS有良好的评估价值，AMH与促黄体生成素、雌二醇呈显著正相关关系。

参考文献

[1]Kaur I,Suri V,Sachdeva N,et al.Efficacy of multi-strain probiotic along with dietary and lifestyle modifications on polycystic ovary syndrome: a randomised,double-blind placebo-controlled study[J].Eur J Nutr,2022,61(8):4145-4154.

[2]Wang C,Wu W,Yang H,et al.Mendelian randomization analyses for PCOS: evidence,opportunities,and challenges[J].Trends Genet,2022,38(5):468-482.

[3]Siddiqui S,Mateen S,Ahmad R,et al.A brief insight into the etiology,genetics,and immunology of polycystic ovarian syndrome (PCOS)[J].J Assist Reprod Genet,2022 ,39(11):2439-2473.

[4]焦艳,王娇,杨志琴,等.多囊卵巢综合征患者IGF-1、ADAMTS-1及sST2的表达及临床意义[J].空军航空医学,2022,39(5):248-251.

[5]唐晓聪.多囊卵巢综合征患者血清AMH、基础激素检测的意义及临床应用研究[J].首都食品与医药,2023,30(4):74-76.

[6]Moolhuijsen LME,Louwers YV,McLuskey A,et al.Association between an AMH promoter polymorphism and serum AMH levels in PCOS patients[J].Hum Reprod,2022,37(7):1544-1556.

[7]Malhotra N,Mahey R,Cheluvaraju R,et al.Serum anti-mullerian hormone (AMH) levels among different PCOS phenotypes and its correlation with clinical,endocrine,and metabolic markers of PCOS[J].Reprod Sci,2023,30(8):2554-2562.

[8]全国卫生产业企业管理协会妇幼健康产业分会生殖内分泌.青春期多囊卵巢综合征诊治共识[J].生殖医学杂志,2016,25(9):767-770.

[9]Abedini M,Ramezani-Jolfaie N,Ghasemi-Tehrani H,et al.The effect of concentrated pomegranate juice on biomarkers of inflammation,oxidative stress,and sex hormones in overweight and obese women with polycystic ovary syndrome:A randomized controlled trial[J].Phytother Res,2023,37(6):2255-2261.

[10]Pingarrón Santofímia C,Poyo Torcal S,López Verdú H,et al Evaluation of the efficacy of an antioxidant combination for the modulation of metabolic,endocrine,and clinical parameters in patients with polycystic ovary syndrome[J].Gynecol Endocrinol,2023,39(1):2227277.

[11]Zhang Y,Lin Y,Li G,et al.Glucagon-like peptide-1 receptor agonists decrease hyperinsulinemia and hyperandrogenemia in dehydroepiandrosterone-induced polycystic ovary syndrome mice and are associated with mitigating inflammation and inducing browning of white adipose tissue[J].Biol Reprod,2023,108(6):945-959.

[12]Kataoka J,Larsson I,Lindgren E,et al.Circulating anti-müllerian hormone in a cohort-study of women with severe obesity with and without polycystic ovary syndrome and the effect of a one-year weight loss intervention[J].Reprod Biol Endocrinol,2022,20(1):153.

[13]Jiang L,Ruan X,Li Y,et al.Diagnostic value of anti-müllerian hormone combined with androgen-levels in Chinese patients with polycystic ovary syndrome[J].Gynecol Endocrinol,2023,39(1):2206927.

[14]Li M,Ruan X,Ju R,et al.Is anti-Mullerian hormone a useful biomarker in the diagnosis of polycystic ovary syndrome in Chinese adolescents[J].Gynecol Endocrinol,2022,38(2):148-152.

[15]Akad M,Socolov R,Furnică C,et al.Kisspeptin variations in patients with polycystic ovary syndrome-a prospective case control study[J]. Medicina (Kaunas). 2022,58(6):776.

[16]Yin WW,Huang CC,Chen YR,et al.The effect of medication on serum anti-müllerian hormone (AMH) levels in women of reproductive age:a meta-analysis[J].BMC Endocr Disord,2022,22(1):158.

[17]Coyle CS,Prescott M,Handelsman DJ,et al.Chronic androgen excess in female mice does not impact luteinizing hormone pulse frequency or putative GABAergic inputs to GnRH neurons[J].J Neuroendocrinol,2022,34(4):e13110.

[18]Stone T,Yanes Cardozo LL,Oluwatade TN,et al.Testosterone-associated blood pressure dysregulation in women with androgen excess polycystic ovary syndrome[J].Am J Physiol Heart Circ Physiol,2023,325(2):H232-H243.

[19]Zhang L,Chen A,Lu J,et al.Effects of sitagliptin on metabolic indices and hormone levels in polycystic ovary syndrome:a meta-analysis of randomized controlled trials[J].Reprod Sci,2023,30(4):1065-1073.

[20]Al Kafhage FA,Abbas AN,Al-Masaoodi RA,et al.The relationship between hormonal levels and hematological parameters in cystic ovarian syndrome[J].J Med Life,2023,16(6):937-940.

[21]钟磊,肖作淼,刘燕,等.血清抗缪勒管激素联合性激素检测对多囊卵巢综合征的临床诊断价值[J].中国当代医药,2022,29(15):115-117,120,封3.

[22]万文英.PCOS伴不孕症患者血清抗苗勒氏管激素、催乳素及性激素的表达及其临床意义[J].中国医学创新,2021,18(34):157-160.

[23]周凤华,黄秋生.泉州地区376例多囊卵巢综合征患者血清AMH与性激素水平的相关性研究[J].医学理论与实践,2022,35(22):3910-3912.

[24]Piltonen TT,Komsi E,Morin-Papunen LC,et al.AMH as part of the diagnostic PCOS workup in large epidemiological studies[J].Eur J Endocrinol,2023,188(6):547-554.

[25]Jiang L,Ruan X,Li Y,et al.Diagnostic value of anti-müllerian hormone combined with androgen-levels in Chinese patients with polycystic ovary syndrome[J].Gynecol Endocrinol,2023,39(1):2206927.

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