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继发性肺结核伴呼吸衰竭患者肺功能与血气指标的相关性 *

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摘要 目的：探讨继发性肺结核伴呼吸衰竭患者肺功能与血气指标的相关性。**方法**：2018 年 3 月到 2020 年 1 月选择在本院诊治的继发性肺结核患者 122 例，所有患者都给予肺功能与血气指标检测，并进行相关性分析。**结果**：122 例患者根据合并呼吸衰竭情况分为呼吸衰竭组(n=48)与非呼吸衰竭组(n=74)。呼吸衰竭组的用力肺活量(Forced vital capacity，FVC)、第一秒用力肺活量(forced expiratory volume in one second，FEV_1)、FEV_1/FVC、MMEF、MEF50、MEF25 值都显著低于非呼吸衰竭组（P<0.05）；呼吸衰竭组的 PaO_2 与 Hb 值显著低于非呼吸衰竭组(P<0.05)，两组 $PaCO_2$、pH 值对比差异无统计学意义(P>0.05)；呼吸衰竭组的低氧血症、高血红蛋白血症等发生率显著高于非呼吸衰竭组(P<0.05)，两组高碳酸血症发生率对比差异无统计学意义(P>0.05)。在呼吸衰竭组中，Spearman 相关性检验分析显示 FVC、FEV_1、FEV_1/FVC、MMEF、MEF50、MEF25 与 PaO_2、Hb 存在相关性(P<0.05)。**结论**：继发性肺结核伴呼吸衰竭患者在临床上比较常见，多伴随有肺功能下降与血气指标异常，呼吸衰竭患者的肺功能与血气指标存在相关性。

关键词：继发性肺结核；呼吸衰竭；肺功能；血气指标；相关性

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Correlation between Lung Function and Blood Gas Indexes in Patients with Secondary Tuberculosis Combined with Respiratory Failure*

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ABSTRACT Objective: To investigate the correlation between lung function and blood gas indexes in patients with secondary tuberculosis combined with respiratory failure. **Methods:** A total of 122 patients with secondary pulmonary tuberculosis, who were diagnosed and treated in Affiliated Hospital of Hebei University from March 2018 to January 2020, were chosen as the research subjects and were divided into respiratory failure group (n=48) and non-respiratory failure group (n=74). All the patients were detected for lung function and blood gas indicators, which were given correlation analysis. **Results:** The values of FVC, FEV_1, FEV_1/FVC, MMEF, MEF50 and MEF25 in the respiratory failure group were significantly lower than those in the non-respiratory failure group(P<0.05). The PaO_2 and Hb values in the respiratory failure group were significantly lower than those in the non-respiratory failure group (P<0.05), there were no significant difference in $PaCO_2$ and pH between the two groups(P>0.05). The incidence of hypoxemia and hyperhemoglobinemia in the respiratory failure group were significantly higher than that in the non-respiratory failure group (P<0.05). There was no significant difference in the incidence of hypercapnia compared between the two groups (P>0.05). In the respiratory failure group, Spearman correlation analysis showed that FVC, FEV_1, FEV_1/FVC, MMEF, MEF50, MEF25 were correlated with PaO_2 and Hb (P<0.05). **Conclusion:** Patients with secondary pulmonary tuberculosis combined with respiratory failure are more common clinically, and are usually accompanied by decreased lung function and abnormal blood gas indicators. There is correlation between lung function and blood gas indicators in patients with respiratory failure.

Key words: Secondary tuberculosis; Respiratory failure; Lung function; Blood gas index; Correlation

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前言

肺结核病是慢性传染病，虽然我国结核病控制工作取得显著成效，但是依然是全球肺结核病高负担国家之一[1]。继发性肺结核为肺结核的主要类型，又称成人型肺结核，为原发结核治愈后再次感染的结核杆菌引起的外源性重复感染[2]。有研究发现，多数继发性肺结核患者大多存在不同程度的呼吸功能障碍，病情大多凶险，如处理不当或不及时，可导致患者死亡[3,4]。并且呼吸衰竭多为肺结核的晚期并发症，需要早期进行吸氧、抗结核、抗感染等治疗后，如存在致命性缺氧时，应予以机械通

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气治疗[5]。肺功能为评价肺结核病情的主要指标，可根据 FEV_1 将患者的肺功能进行分级，从而进行病判定[6,7]。不过肺结核的转归是一个复杂的过程，单纯肺功能评估并不能全面反映患者的病情[8,9]。血气分析能反映患者的呼吸功能状况，血气分析指标紊乱可导致机体呼吸道防御功能下降，诱发呼吸衰竭，使得病情难以控制[10,11]。本文具体探讨了继发性肺结核伴呼吸衰竭患者肺功能与血气指标的相关性，希望为患者的病情判定提供参考。现总结报道如下。

1 对象与方法

1.1 研究对象

2018 年 3 月到 2020 年 1 月选择在本院诊治的继发性肺结核患者 122 例，纳入标准：均经实验室检查及胸部影像学检查确诊为肺结核；临床诊断为继发性肺结核；年龄 20~60 岁；患者签署了知情同意书；本研究且得到医院伦理委员会的批准。排除标准：合并肺炎、肿瘤、支气管哮喘等疾病者；合并糖尿病和其它免疫相关疾病者；临床资料缺乏者；近 4 w 内严重心功能不稳定、心绞痛患者；合并恶性肿瘤患者；妊娠与哺乳期妇女。

1.2 肺功能检测

在肺功能检查前测试者向患者进行示范指导，包括屏气、快速呼气、呼气、深吸气等动作，使患者熟练掌握这些呼吸动作。采用德国耶格公司体积描记仪 Master Lab，测试时患者采取端坐位，含紧咬嘴，夹紧鼻夹，测试过程中不漏气，即时做呼气和吸气动作。记录 FVC、FEV_1、FEV_1/FVC、最大用力呼气中段流量(Maximal mid expiratory flow，MMEF)、50 %肺活量最大呼气流量(MEF50)、25 %肺活量最大呼气流量(MEF25)等指标。

1.3 血气指标检测

取所有患者空腹股动脉血 3~4 mL，肝素抗凝，使用动脉血气仪 (丹麦 ABL 型动脉血气仪) 测定 pH、PaO_2、$PaCO_2$、Hb 值。$PaO_2 \leq$ 8 kPa 为低氧血症；$PaCO_2 \geq$ 6.7 kPa 为高碳酸血症；男性 Hb≥ 170 g/L，女性≥ 160 g/L 为高血红蛋白血症。

1.4 统计方法

选择 SPSS 19.00 软件进行分析，计量指标以均数± 标准差表示，用独立样本 t 检验进行组对比；计数指标采用百分比表示，对比用卡方 x^2 检验，采用 Spearman 相关性检验做相关性分析，P<0.05 为有统计学意义。

2 结果

2.1 一般资料对比

根据合并呼吸衰竭情况分为呼吸衰竭组(n=48)与非呼吸衰竭组(n=74)，两组患者的年龄、性别、体重指数、病程、收缩压、舒张压等对比差异无统计学意义(P>0.05)，见表 1。

表 1 两组一般资料对比

Table 1 Comparison of general data between two groups

Groups	n	Age (years)	Gender (male/female)	BMI (kg/m²)	Course (months)	SBP(mmHg)	DBP(mmHg)
Respiratory failure group	48	41.85± 3.18	26/22	22.87± 1.47	6.21± 0.44	128.77± 13.33	78.87± 3.28
Non-respiratory failure group	74	42.09± 2.76	40/34	22.10± 2.11	6.30± 0.45	129.01± 14.02	79.22± 4.11

Note: Diagnostic criteria for respiratory failure: PaO_2<60 mmHg and $PaCO_2$ >50 mmHg in patients breathing indoor air, accompanied by obvious clinical symptoms.

2.2 肺功能指标对比

呼吸衰竭组的 FVC、FEV_1、FEV_1/FVC、MMEF、MEF50、MEF25 值都显著低于非呼吸衰竭组(P<0.05)，见表 2。

表 2 两组肺功能指标对比(%，$\bar{x}\pm s$)

Table 2 Comparison of lung function indexes between two groups (%, $\bar{x}\pm s$)

Groups	n	FVC	FEV_1	FEV_1/FVC	MMEF	MEF50	MEF25
Respiratory failure group	48	51.49± 2.19*	34.98± 2.85*	50.78± 0.82*	12.09± 1.48*	10.77± 1.00*	22.17± 1.74*
Non-respiratory failure group	74	72.08± 1.47	65.19± 3.33	64.57± 3.00	22.76± 2.22	19.76± 1.74	33.98± 3.11

Note: *P<0.05 compared with non-respiratory failure group.

2.3 血气指标对比

呼吸衰竭组的 PaO_2 与 Hb 值显著低于非呼吸衰竭组(P<0.05)，两组 $PaCO_2$、pH 值对比差异无统计学意义(P>0.05)，见表 3。

表 3 两组血气指标对比($\bar{x}\pm s$)

Table 3 Comparison of blood gas indexes between two groups ($\bar{x}\pm s$)

Groups	n	pH	PaO_2(kPa)	$PaCO_2$(kPa)	Hb(g/L)
Respiratory failure group	48	7.42± 0.13	6.82± 0.33*	7.71± 1.33	140.29± 4.23*
Non-respiratory failure group	74	7.44± 0.12	7.57± 1.11	7.69± 1.87	162.09± 8.82

呼吸衰竭组的低氧血症、高血红蛋白血症等发生率显著高于非呼吸衰竭组(P<0.05)，两组高碳酸血症发生率对比差异无统计学意义(P>0.05)，见表 4。

表 4 两组血气异常相关疾病发生率对比(例,%)

Table 4 Comparison of incidence of blood gas abnormalities between two groups (n,%)

Groups	n	Hypoxemia	Hyperhemoglobinemia	Hypercapnia
Respiratory failure group	48	22(45.8)*	14(29.2)*	8(16.7)
Non-respiratory failure group	74	9(12.2)	5(6.8)	12(16.2)

2.4 相关性分析

在呼吸衰竭组中,Spearman 相关性检验分析显示 FVC、FEV_1、FEV_1/FVC、MMEF、MEF50、MEF25 与 PaO_2、Hb 存在相关性(P<0.05),见表 5。

表 5 继发性肺结核伴呼吸衰竭患者肺功能与血气指标的相关性(n=48)

Table 5 Correlation between lung function and blood gas indicators in patients with secondary tuberculosis with respiratory failure (n=48)

Index	FVC	FEV_1	FEV_1/FVC	MMEF	MEF50	MEF25
PaO_2-r	0.443	0.562	0.613	0.492	0.487	0.388
P	0.013	0.002	0.000	0.010	0.011	0.029
Hb-r	0.429	0.513	0.559	0.487	0.412	0.367
P	0.015	0.008	0.003	0.011	0.027	0.031

3 讨论

肺结核是一种由空气传播的慢性传染性疾病,当前由于流动人口增多以及耐药结核病的发展,使得继发性结核病重新成为我国的公共卫生问题 [12]。继发性肺结核伴呼吸衰竭比较常见,且每年呈现逐渐上升的趋势,且是诱发和加重患者病情加重的主要原因[13]。而由于呼吸衰竭患者的抵抗力下降,极易再次受到结核杆菌的感染而并发继发性结核病[14,15]。本研究显示在 122 例患者中,并发呼吸衰竭 48 例;呼吸衰竭组的 FVC、FEV_1、FEV_1/FVC、MMEF、MEF50、MEF25 值都显著低于非呼吸衰竭组。与陈纯[16]等学者的研究类似,探讨慢性阻塞性肺疾病合并呼吸道病毒感染患者的肺功能、血清免疫球蛋白轻链和炎性细胞因子水平的相关性,结果显示合并呼吸道病毒感染组患者的 6MWT、FVC、FEV_1 和 FEV_1/FVC 等肺功能指标均低于慢性阻塞性肺病组。从机制上分析,肺结核主要结核菌可侵及肺实质的破坏致纤维改变,引起肺功能改变,并致肺血管结构改变,可因缺氧导致代偿性通气增加,造成通气 / 血流比例失调或弥散功能障碍,使 CO_2 过度排出而引起呼吸性碱中毒,诱发导致呼吸衰竭[17,18]。

肺结核可造成患者呼吸道防御功能下降,引起肺部感染,诱发呼吸衰竭的发生[19]。并且肺结核病灶可累及支气管腔形成瘢痕挛缩,压迫支气管及其分支,使支气管腔狭窄导致气流受限[20];影响肺组织的顺应性。肺结核也可导致机体大量分泌炎症因子,导致支气管壁纤维化的形成,进一步导致气道狭窄,使推动呼吸道内气体流动的动力下降,促进气流受限发生[21]。本研究显示呼吸衰竭组的 PaO_2 与 Hb 值显著低于非呼吸衰竭组,两组 $PaCO_2$、pH 值对比差异无统计学意义;呼吸衰竭组的低氧血症、高血红蛋白血症等发生率显著高于非呼吸衰竭组,两组高碳酸血症发生率对比差异无统计学意义,与刘业成[22]等学者分析严重肥胖伴呼吸衰竭患者机械通气时发病情况和呼吸支持情况,探究其死亡危险因素,结果显示无创通气 2 h 后生存组 $PaCO_2$ 和 pH 值显著高于通气前,PaO_2 与通气前比较差异无统计学意义。呼吸衰竭可导致机体通气障碍与呼吸弥散功能下降,使得 PaO_2 值下降,严重情况下可导致肺动脉高压[23]。而慢性的缺氧使得血红蛋白、红细胞代偿性合成增加,诱发机体出现高血红蛋白血症,后者可增加血液粘滞度,提高肺循环阻力,从而形成恶性循环,加重患者的病情[24]。有研究显示呼吸衰竭所引起缺氧和 CO_2 潴留可影响结核菌生长繁殖环境有关,从而影响结核菌侵及肺实质的破坏,但不会影响 $PaCO_2$ 值[25]。还有研究表明肺结核并发呼吸衰竭初期多为Ⅰ型呼衰,病危及临终期以Ⅱ型呼衰为主,采用动脉血气分析能帮助判断重症患者病情及预后[26,27]。

对于继发性肺结核患者而言,当病灶范围≥ 4 个肺野后,可对肺部功能产生严重损伤,使通气受到限制,诱发机体出现呼吸衰竭[28,29]。本研究 Spearman 相关性检验分析显示继发性肺结核伴呼吸衰竭患者的 FVC、FEV_1、FEV_1/FVC、MMEF、MEF50、MEF25 与 PaO_2、Hb 存在相关性,刘俊强[30]的研究类似,研究 COPD 患者 CT 血管成像结果与患者肺功能参数,血气分析结果的相关性,Pearson 相关性分析显示,左侧和右侧支气管动脉管径与 FEV_1/FVC,MEF25,MEF50,MEF25-75 以及 PaO_2 呈负相关。从机制上分析,肺结核引起肺组织实质性破坏,易引起支气管狭窄与呼吸道炎症水肿,呼吸道分泌物不能有效排除,导致患者肺功能降低,使得机体换气和通气功能双重障碍,导致血气指标异常,临床上以严重缺氧和 CO_2 潴留多见[31-33]。不过本研究没有进行不同时间点的动态分析,且没有进行静脉血气分析,将在后续研究中深入探讨。

总之,继发性肺结核伴呼吸衰竭患者在临床上比较常见,多伴随有肺功能下降与血气指标异常,呼吸衰竭患者的肺功能与血气指标存在相关性。

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