

doi: 10.13241/j.cnki.pmb.2014.10.026

肺通气功能程度与慢性阻塞性肺疾病患者夜间低氧发生的相关性分析*

宋爱玲 卜丽娜[△] 贾卫红 韩燕燕 杨栋才 温鸿请

(陕西省西安市第二医院呼吸内科 陕西 西安 710036)

摘要 目的:研究肺通气功能程度与慢性阻塞性肺疾病患者夜间低氧发生的相关性。**方法:**选取2012年1月至2013年6月我院治疗的60例稳定期慢性阻塞性肺疾病患者,按肺通气功能分为轻度、中度、重度、极重度4组,每组15例,监测记录研究对象肺通气功能指标及夜间血氧指标,比较各组监测指标的差异,并分析其相关性。**结果:**不同病情程度COPD患者FEV1/FVC、FEV1、FVC、PEF、RV、RV/TLC、MsaO₂、ODI、WsaO₂、LsaO₂、SIT90%有差异(P<0.05);极重度和重度比较FEV1/FVC、FEV1、RV、MsaO₂、ODI、WsaO₂、LsaO₂、SIT90%有差异(P<0.05);极重度和中度比较FEV1/FVC、FEV1、FVC、PEF、RV、RV/TLC、MsaO₂、ODI、WsaO₂、LsaO₂、SIT90%有差异(P<0.05);极重度和轻度比较FEV1/FVC、FEV1、FVC、PEF、RV、RV/TLC、MsaO₂、ODI、WsaO₂、LsaO₂、SIT90%有差异(P<0.05);重度和中度比较FEV1/FVC、FEV1、FVC、PEF、RV/TLC、MsaO₂有差异(P<0.05);重度和轻度比较FEV1/FVC、FEV1、FVC、PEF、RV/TLC、MsaO₂、ODI、LsaO₂有差异(P<0.05);中度和轻度比较FEV1/FVC、FEV1、FVC、PEF、ODI有差异(P<0.05)。COPD患者的肺通气功能FEV1与MsaO₂呈正相关(r=0.683, P<0.05)。**结论:**肺通气功能程度与慢性阻塞性肺疾病患者夜间低氧发生具有相关性。

关键词:肺通气功能;夜间低氧;慢性阻塞性肺疾病

中图分类号:R563.3 文献标识码:A 文章编号:1673-6273(2014)10-1911-03

Correlation Between the Degree of Pulmonary Ventilation Function and Nocturnal Hypoxia Occurs in Patients With Chronic Obstructive Pulmonary Disease*

SONG Ai-ling, BU Li-na[△], JIA Wei-hong, HAN Yan-yan, YANG Dong-cai, WEN Hong-qing

(Department of Respiratory Medicine, Xi'an Second Hospital of Shaanxi Province, Xi'an, Shaanxi, 710036, China)

ABSTRACT Objective: To study the correlation between the degree of pulmonary ventilation function and nocturnal hypoxia occurs in patients with chronic obstructive pulmonary disease. **Methods:** Selected 60 patients with stable chronic obstructive pulmonary disease from January 2012 to June 2013 in our hospital, divided into mild, moderate, severe, very severe four groups by pulmonary function, 15 cases in each group, monitoring records studied pulmonary function indicators and nocturnal oxygen index, comparing the differences of indicators in each group, and analyze their relevance. **Results:** Among four groups COPD FEV1/FVC, FEV1, FVC, PEF, RV, RV / TLC, MsaO₂, ODI, WsaO₂, LsaO₂, SIT90% had differences (P<0.05); compared very severe and severe group FEV1/FVC, FEV1, RV, MsaO₂, ODI, WsaO₂, LsaO₂, SIT90% had differences (P<0.05); compared very severe and moderate group FEV1/FVC, FEV1, FVC, PEF, RV, RV / TLC, MsaO₂, ODI, WsaO₂, LsaO₂, SIT90% had differences (P<0.05); compared very severe and mild group FEV1/FVC, FEV1, FVC, PEF, RV, RV / TLC, MsaO₂, ODI, WsaO₂, LsaO₂, SIT90% had differences (P<0.05); compared severe and moderate group FEV1/FVC, FEV1, FVC, PEF, RV / TLC, MsaO₂ had differences (P<0.05); compared severe and mild group FEV1/FVC, FEV1, FVC, PEF, RV / TLC, MsaO₂, ODI, LsaO₂ had differences (P<0.05); compared moderate and mild group FEV1/FVC, FEV1, FVC, PEF, ODI had differences (P<0.05). Pulmonary function in patients with COPD MsaO₂ was positively correlated with FEV1 (r = 0.783, P<0.05). **Conclusion:** pulmonary ventilation function correlated with the degree of chronic obstructive pulmonary disease in patients with nocturnal hypoxia.

Key words: Pulmonary ventilation function; Nocturnal hypoxia; Chronic obstructive pulmonary disease

Chinese Library Classification(CLC): R563.3 **Document code:** A

Article ID: 1673-6273(2014)10-1911-03

* 基金项目:西安市卫生局科研项目(2012004)

作者简介:宋爱玲(1981-),女,硕士,住院医师,从事慢性阻塞性肺疾病方面,

E-mail:xxz08765@126.com

△ 通讯作者:卜丽娜(1976-),女,在读博士,副主任医师,从事慢性阻塞性肺疾病方面

(收稿日期:2013-11-08 接受日期:2013-11-30)

前言

慢性阻塞性肺疾病 (chronic obstructive pulmonary disease, COPD) 是一种重要的慢性呼吸系统疾病, 患病人数极多, 且病死率较高, COPD 进行性发展疾病, 患者的劳动能力和生活质量会逐渐降低^[1-3]。COPD 急性发作期过后, 虽然临床症状有所缓解, 但是其肺功能仍然在继续恶化, 并且因为患者自身防御和免疫功能的下降以及外界各种危险因素的影响, 容易造成患者反复发作, 而引起各种心肺并发症^[4-6]。COPD 进展的终末阶段为呼吸衰竭, 早期或轻度的呼吸衰竭通常只存在血氧水平的下降, 而低氧血症一般最早在睡眠状态时发生, 夜间低氧会诱发肺动脉高压、心律失常及猝死^[7]。因此, COPD 夜间死亡率较日间更高。睡眠是 COPD 患者生理功能紊乱最为严重的时期, 因而也是最危险的时期, 严重 COPD 患者常因睡眠时呼吸暂停导致死亡或造成各种心血管意外^[8]。所以了解 COPD 睡眠低氧的影响因素, 从而预测患者睡眠低氧发生的可能性, 并针对性提供预防措施和及早治疗, 有重要的临床实际意义。本次研究收集 2012 年 1 月至 2013 年 6 月我院治疗的 60 例稳定期慢性阻塞性肺疾病患者, 监测记录研究对象肺通气功能指标及夜间血氧指标, 探讨肺通气功能程度与慢性阻塞性肺疾病患者夜间低氧发生的相关性。现报告如下。

1 资料与方法

1.1 对象选择

入选 2012 年 1 月至 2013 年 6 月我院治疗的 60 例稳定期慢性阻塞性肺疾病患者, 男 48 例, 女 12 例, 年龄 (57.61±17.43) 岁, 按肺通气功能分为轻度、中度、重度、极重度 4 组, 每组 15 例。患者均确诊为 COPD, 同时排除 COPD 伴阻塞性睡眠呼吸暂停、其他原因所致夜间低氧。本研究已获得我院伦理委员会批准, 且所有研究对象均签署知情同意书。各组患者在年龄构成、性别构成、文化构成、职业分布及病情等方面差异无统计学意义 ($P>0.05$), 资料具有可比性。

1.2 方法

1.2.1 肺通气功能分级 I 级 (轻度): 第 1 秒用力呼气容积 (Forced expiratory volume in one second, FEV1)/肺活量 (FVC) < 70%, FEV1 占预计值百分比 (FEV1%) $\geq$ 80%, 气流受限, 且不能完全逆转, 有或无慢性咳嗽、咳痰症状; II 级 (中度):

FEV1/FVC < 70%, 50% $\leq$ FEV1% < 80% 预计值, 气流受限进一步恶化, 并有症状进展和气短, 以及慢性咳嗽、咳痰、活动后呼吸困难等症状; III 级 (重度): FEV1%/FVC < 70%, 30% $\leq$ FEV1% < 50%, 多伴有慢性咳嗽、咳痰、气短加剧、呼吸困难症状, 并且反复出现急性加重; IV 级 (极重度): FEV1%/FVC < 70, FEV1% < 30%, 伴有慢性呼吸衰竭, 合并肺心病及右心功能不全或衰竭, 生活质量明显下降。

1.2.2 夜间睡眠监测 采用美国邦德安百便携式睡眠呼吸监测仪, 所有研究对象监测前 24h 内不可以饮酒或服用安眠药, 全夜 7~8h 连续监测, 监测时研究对象不吸氧, 监测研究对象整夜多导睡眠图, 观察指标包括平均血氧饱和度 (MsaO₂)、氧减饱和度指数 (ODI)、清醒时 MsaO₂ (WsaO₂)、最低血氧饱和度 (LsaO₂)、血氧饱和度低于 90% 占整个记录时间的百分比 (T<90%)。

1.2.3 肺通气功能监测 采用便携式肺功能测定仪, 测量患者的 FEV1 占预计值百分比 (FEV1%)、第 1 秒用力呼气容积/肺活量 (FEV1/FVC)、肺活量 (FVC)、最大呼气流量 (PEF)、残气容积 (RV)、残气容积/肺总量 (RV/TLC), 每例研究对象均测量 3 次肺功能, 取最大值为该研究对象监测数据。

1.4 统计学分析

此次研究所得数据采用 Excel 建立数据库, 由录入人员双人双录入且进行数据校对, 采用 SPSS20.0 统计软件进行统计分析, 计量资料以均数±标准差 ($\bar{x} \pm s$) 表示; 四组资料比较时采用方差分析, 多重比较采用 LSD-t 检验; 各指标见相关性分析采用 Pearson 积差相关分析。检验水准 $\alpha=0.05$ 。

2 结果

2.1 不同病情程度 COPD 患者肺通气功能比较

不同病情程度 COPD 患者肺通气功能有差异 ($P<0.05$); 极重度和重度比较 FEV1/FVC、FEV1、RV 有差异 ($P<0.05$); 极重度和中度比较 FEV1/FVC、FEV1、FVC、PEF、RV、RV/TLC 有差异 ($P<0.05$); 极重度和轻度比较 FEV1/FVC、FEV1、FVC、PEF、RV、RV/TLC 有差异 ($P<0.05$); 重度和中度比较 FEV1/FVC、FEV1、FVC、PEF、RV/TLC 有差异 ($P<0.05$); 重度和轻度比较 FEV1/FVC、FEV1、FVC、PEF、RV/TLC 有差异 ($P<0.05$); 中度和轻度比较 FEV1/FVC、FEV1、FVC、PEF 有差异 ($P<0.05$)。见表 1。

表 1 不同病情程度 COPD 患者肺通气功能比较 ($\bar{x} \pm s$)

Table 1 Comparison of pulmonary ventilation function in patients with different severity of COPD ($\bar{x} \pm s$)

病情程度 Severity of disease	n	FEV1/FVC(%)	FEV1(%)	FVC(L)	PEF(L/s)	RV(L)	RV/TLC
轻度 Mild	15	62.56±3.94	87.39±9.94	3.62±0.70	6.59±2.20	2.16±0.41	0.46±0.05
中度 Moderate	15	56.25±6.11 ^a	65.58±3.28 ^a	2.85±0.61 ^a	4.22±1.75 ^a	2.25±0.59	0.48±0.02
重度 Severe	15	50.99±5.34 ^{ab}	47.48±9.30 ^{ab}	2.04±0.53 ^{ab}	2.93±1.26 ^{ab}	2.38±0.23	0.54±0.06 ^{ab}
极重度 Extremely severe	15	40.26±6.49 ^{abc}	22.77±3.69 ^{abc}	1.73±0.28 ^{ab}	2.57±1.22 ^{ab}	3.44±0.43 ^{abc}	0.56±0.07 ^{ab}

Note: a compared with mild, $P<0.05$; b compared with moderate, $P<0.05$; c compared with severe, $P<0.05$.

2.2 不同病情程度 COPD 患者夜间血氧指标比较

不同病情程度 COPD 患者 MsaO₂、ODI、WsaO₂、LsaO₂、SIT90% 有差异 ($P<0.05$); 极重度和重度比较 MsaO₂、ODI、

WsaO₂、LsaO₂、SIT90% 有差异 ($P<0.05$); 极重度和中度比较 MsaO₂、ODI、WsaO₂、LsaO₂、SIT90% 有差异 ($P<0.05$); 极重度和轻度比较 MsaO₂、ODI、WsaO₂、LsaO₂、SIT90% 有差异 ($P<0.05$);

重度和中度比较 MsaO₂ 有差异 (P<0.05); 重度和轻度比较 MsaO₂、ODI、LsaO₂ 有差异 (P<0.05); 中度和轻度比较 ODI 有

表 2 不同病情程度 COPD 患者夜间血氧指标比较($\bar{x} \pm s$)Table 2 Table 1 Comparison of nocturnal oxygen index in patients with different severity of COPD($\bar{x} \pm s$)

病情程度 Severity of disease	n	MsaO ₂ (%)	ODI(次/h)	WsaO ₂ (%)	LsaO ₂ (%)	SIT90%(%)
轻度 Mild	15	94.16± 3.99	2.59± 3.20	95.16± 1.71	84.09± 9.19	2.29± 4.31
中度 Moderate	15	92.76± 2.54	5.01± 0.75 ^a	93.51± 2.59	80.09± 8.09	6.62± 8.03
重度 Severe	15	89.32± 1.81 ^{ab}	5.93± 2.26 ^a	94.37± 2.04	76.01± 5.36 ^a	11.54± 7.30
极重度 Extremely severe	15	84.51± 5.63 ^{abc}	10.59± 4.22 ^{abc}	87.84± 4.83 ^{abc}	61.84± 12.81 ^{abc}	67.27± 31.36 ^{abc}

Note: a compared with mild, P<0.05; b compared with moderate, P<0.05; c compared with severe, P<0.05.

2.3 相关分析

Pearson 相关分析显示, COPD 患者的肺通气功能 FEV1 与 MsaO₂ 呈正相关($r=0.683$, $P<0.05$)。该结果提示, COPD 患者夜间低氧发生与其肺通气功能程度相关。

3 讨论

慢性阻塞性肺疾病(COPD)外周气道、中央气道、肺实质和肺的血管系统存在特征性的病理学改变;外周气道慢性炎症导致气道壁损伤和修复过程反复发生,进一步导致气道壁结构重塑,胶原含量增加及瘢痕组织形成;中央气道炎性细胞浸润表层上皮,导致杯状细胞增多和黏液分泌腺增大,从而引起黏液分泌增加;这些病理学改变导致气腔狭窄,造成固定性气道阻塞^[9-11]。COPD 在发展成呼吸衰竭前,其夜间的血氧含量已达到呼吸标准, COPD 患者在夜间睡眠时氧饱和度较醒觉时低,加速一系列并发症的发生,称为夜间低氧血症(NOD)^[12-14]。正常人睡眠时血氧水平也会出现轻度下降,但无临床意义,而 COPD 患者普遍存在睡眠呼吸紊乱现象,部分患者在睡眠期间出现有临床意义的血氧水平下降,这种夜间血氧水平下降可能会诱发肺动脉高压、夜间心律失常及睡眠时猝死^[15-16]。因此,这可能是造成 COPD 患者夜间或凌晨病情加重、死亡率升高,远期生存率下降的原因。

夜间低氧血症可能是 COPD 患者呼吸肌疲劳,低通气上气道阻力增加,通气/血流比值失调,呼吸驱动降低而引起的^[17];此外, COPD 患者睡眠时低通气及其引起的肺泡通气量的不足、通气/血流比值失调、功能残气量减少也是 COPD 发生睡眠低氧的原因^[18];另外, COPD 患者存在不可逆性气道阻塞,呼吸肌疲劳,长期处于超负荷工作状态^[9];睡眠中神经肌肉的活性降低,对某些物理或化学刺激的反应变弱,造成疲劳的呼吸肌工作效率变得更低,更加不能有效代偿相应潮气量的降低,亦是导致睡眠低氧的重要原因^[20]。

本次研究结果表明,不同病情程度 COPD 患者肺通气功能及夜间血氧指标存在差异, COPD 患者的肺通气功能 FEV1 与 MsaO₂ 呈正相关。该结果说明,随着病情的家中患者肺通气功能下降,夜间血氧指标也下降,提示肺通气功能程度与慢性阻塞性肺疾病患者夜间低氧发生具有相关性。综上所述,慢性阻塞性肺疾病患者夜间低氧的发生可能和患者肺通气功能下降有关,我们应注意慢性阻塞性肺疾病患者夜间低氧的发生的警示,及早做好预防和治疗工作。

参考文献(References)

- [1] Chen Chang-zhi, Zhu Gui-Chao, Tan Jia-meng, et al. Study of Chronic Obstructive Pulmonary Disease with Acute Exacerbation of Coagulation Characteristics[J]. Guangxi Medical Journal, 2011, 33(12): 1560-1563
- [2] Zhu Yan-hong, Li Yuan-jun, Zhang Ge-ping, et al. Clinical of Home Oxygen Therapy Combined with Breathing Exercises in Treatment of Chronic Obstructive Pulmonary Disease[J]. Progress in Modern Biomedicine, 2013, 13(23): 4551-4554
- [3] Luo Hong-yan, Lan Xiao-mei, Cao Li, et al. Relative Biomarkers of Early Stage Renal Injury in Patients with the Chronic Hypoxia[J]. Journal of Ningxia Medical University, 2013, 35(6): 626-630
- [4] Gao Y, Hou Q, Wang H. Assessment of health status in patients with newly diagnosed chronic obstructive pulmonary disease[J]. PLoS One, 2013, 8(12): 82782
- [5] Roca M, Mitu F, Roca I C, et al. Body composition alterations in chronic obstructive pulmonary disease[J]. Rev Med Chir Soc Med Nat Iasi, 2013, 117(2): 337-343
- [6] Ghattas C, Dai A, Gemmel D J, et al. Over diagnosis of chronic obstructive pulmonary disease in an underserved patient population [J]. Int J Chron Obstruct Pulmon Dis, 2013, 8: 545-549
- [7] Ives S J, Harris R A, Witman M A, et al. Vascular Dysfunction and Chronic Obstructive Pulmonary Disease: The Role of Redox Balance [J]. Hypertension, 2013
- [8] Doufas A G, Tian L, Davies M F, et al. Nocturnal intermittent hypoxia is independently associated with pain in subjects suffering from sleep-disordered breathing[J]. Anesthesiology, 2013, 119(5): 1149-1162
- [9] Barnes P J. Chronic obstructive pulmonary disease: important advances[J]. Lancet Respir Med, 2013, 1(1): e7-e8
- [10] Robles P G, Brooks D, Goldstein R, et al. Gender-Associated Differences in Pulmonary Rehabilitation Outcomes in People With Chronic Obstructive Pulmonary Disease: A SYSTEMATIC REVIEW[J]. J Cardiopulm Rehabil Prev, 2013
- [11] Chung V C, Ma P H, Hui D S, et al. Indacaterol for chronic obstructive pulmonary disease: systematic review and meta-analysis[J]. PLoS One, 2013, 8(8): e70784
- [12] Okur H K, Pelin Z, Yuksel M, et al. Lipid peroxidation and paraoxonase activity in nocturnal cyclic and sustained intermittent hypoxia [J]. Sleep Breath, 2013, 17(1): 365-371

- [4] 刘沐青, 郭霞, 王晓云. 低强度脉冲超声波防止废用性骨质疏松症[J]. 科技导报, 2010, (11): 43-46
Liu Mu-qing, Guo Xia, Wang Xiao-yun. Effects of Low Intensity Pulsed Ultrasound on Prevention of Disused Osteoporosis [J]. Science & Technology Review, 2010, (11): 43-46
- [5] 蒋欣益, 杨霖, 柴召午, 等. 低强度脉冲超声波联合引导骨组织再生促进牙周骨缺损修复的实验研究 [J]. 华西口腔医学杂志, 2012, 30(5): 487-492
Jiang Xin-yi, Yang Ji, Chai Zhao-wu, et al. Low intensity pulsed ultrasound irradiating combined with guided bone regeneration for promoting the repair effect of periodontal bone defect[J]. West China Journal of Stomatology, 2012, 30(5): 487-492
- [6] 张保中, 邱贵兴, 吴志宏. 低强度超声波促进骨折愈合过程中 I, X 型胶原蛋白的基因表达[J]. 中国骨与关节外科, 2008, 1(4): 295-300
Zhang Bao-zhong, Qiu Gui-xing, Wu Zhi-hong. Gene expression of Collagen I and Collagen X during bone healing after low intensity ultrasound stimulation[J]. Chinese Journal Bone and Joint Surgery, 2008, 1(4): 295-300
- [7] Rauh KH, Andersen RS, Rosenberg J. Visual analogue scale for measuring post-operative pain[J]. Ugeskr Laeger, 2013, 175(24): 1712-1716
- [8] Wood TJ, Sameem M, Farrokhlyar F, et al. A systematic review of rehabilitation protocols following surgical repair of the extensor pollicis longus[J]. Hand Therapy, 2013, 18(1): 3-10
- [9] Kouzaki M, Masani K. Postural sway during quiet standing is related to physiological tremor and muscle volume in young and elderly adults[J]. Gait Posture, 2012, 35(1): 11-17
- [10] Lee H, Hou Z, Liu P, et al. An experimental study comparing active mobilization to passive flexion-active extension-active flexion after flexor tendon repair in zone 2 [J]. J Hand Surg Am, 2013, 38(4): 672-676
- [11] Altobelli GG, Conneely S, Haufler C, et al. Outcomes of Digital Zone IV and V and Thumb Zone TI to TIV Extensor Tendon Repairs Using a Running Interlocking Horizontal Mattress Technique [J]. J Hand Surg Am, 2013, 38(6): 1079-1083
- [12] Starnes T, Saunders RJ, Means KR, Jr. Clinical outcomes of zone II flexor tendon repair depending on mechanism of injury [J]. J Hand Surg Am, 2012, 37(12): 2532-2540
- [13] 冯会成, 黄迅悟, 孙继桐, 等. 关节镜下应用带跟骨异体跟腱联合重建前交叉韧带及内侧副韧带 [J]. 现代生物医学进展, 2013, 13: 2472-2475
Feng Hui-cheng, Huang Xun-wu, Sun Ji-tong, et al. Reconstruction of Both Anterior Cruciate Ligament and Medial Collateral Ligament Using calcanei Combined Achilles Tendon Allograft Under Arthroscopy[J]. Progress in Modern Biomedicine, 2013, 13: 2472-2475
- [14] Jones ME, Burnett S, Southgate A, et al. The role of human-derived fibrin sealant in the reduction of postoperative flexor tendon adhesion formation in rabbits[J]. J Hand Surg Br, 2002, 27(3): 278-282
- [15] 石继祥. 促进肌腱愈合及预防肌腱粘连的研究进展 [J]. 中国修复重建外科杂志, 2005, 19(5): 400-403
Shi Ji-xiang. The research progress of acceleration tendon and prevention tendon adhesion[J]. Chinese Journal of Reparative and Reconstructive Surgery, 2005, 19(5): 400-403
- [16] 周秀军. 不同生物材料预防肌腱损伤后粘连的评价[J]. 中国组织工程研究与临床康复, 2010, 14(21): 3915-3918
Zhou Xiu-jun. Evaluation on different biological materials to prevent adhesions after tendon injury [J]. Journal of Clinical Rehabilitative Tissue Engineering Research, 2010, 14(21): 3915-3918
- [17] Bijak M, Girsch W, Rafolt D, et al. EMG monitoring in functional electrostimulation[J]. Biomed Tech (Berl), 2000, 45(4): 93-97
- [18] Young RG, Butler DL, Weber W, et al. Use of mesenchymal stem cells in a collagen matrix for Achilles tendon repair [J]. J Orthop Res, 1998, 16(4): 406-413
- [19] Kokubu T, Matsui N, Fujioka H, et al. Low intensity pulsed ultrasound exposure increases prostaglandin E2 production via the induction of cyclooxygenase-2 mRNA in mouse osteoblasts [J]. Biochem Biophys Res Commun, 1999, 256(2): 284-287
- [20] Yeung CK, Guo X, Ng YF. Pulsed ultrasound treatment accelerates the repair of Achilles tendon rupture in rats [J]. J Orthop Res, 2006, 24(2): 193-201

(上接第 1913 页)

- [13] 徐德华, 夏家惠, 李娟, 等. 不同气候条件下慢性阻塞性肺疾病的病原学和免疫学研究[J]. 现代生物医学进展, 2011, 11(20): 3845-3848
Xu De-hua, Xia Jia-hui, Li Juan, et al. Etiology and Immunology in Chronic Obstructive Pulmonary Disease under Different Climatic Conditions[J]. Progress in Modern Biomedicine, 2011, 11(20): 3845-3848
- [14] Liang Zhi-qiang. Effect Evaluation of Community Rehabilitation Therapy of Elderly Patients with Chronic Obstructive Pulmonary Disease[J]. Journal of Liaoning Medical University, 2013, 34(4): 76-78
- [15] Muraki I, Tanigawa T, Yamagishi K, et al. Nocturnal intermittent hypoxia and metabolic syndrome; the effect of being overweight: the CIRCS study[J]. J Atheroscler Thromb, 2010, 17(4): 369-377
- [16] Tkacova R, Pobeha P, Ukropcova B, et al. Macronutrient preferences in patients with chronic obstructive pulmonary disease and hypoxemia[J]. Nutrition, 2011, 27(10): 1093-1094
- [17] Gumus A, Kayhan S, Cinarka H, et al. High serum YKL-40 level in patients with COPD is related to hypoxemia and disease severity[J]. Tohoku J Exp Med, 2013, 229(2): 163-170
- [18] Valipour A, Burghuber O C. Hypoxemia and cardiovascular disease in COPD. Not related to sleep disordered breathing after all[J]. Sleep Med, 2012, 13(2): 214
- [19] Kent B D, Mitchell P D, McNicholas W T. Hypoxemia in patients with COPD: cause, effects, and disease progression [J]. Int J Chron Obstruct Pulmon Dis, 2011, 6: 199-208
- [20] Kjeldgaard P, Ringbaek T, Lange P. Oxygen therapy in exercise-induced hypoxemia improves physical capacity and reduces dyspnea in patients with COPD[J]. Ugeskr Laeger, 2011, 173(23): 1635-1640