

# 铍病患者呼吸功能的测定与分析

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**内容提要** 对12例铍病、19例可疑铍病,以及10例铍接触者进行了肺功能测定及血气分析。结果铍病组RV、RV/TLC升高、VC、FVC、FEV<sub>1</sub>/FVC均显著降低,与其他两组比较,差异非常显著(P<0.01。)MMEF、 $\dot{V}_{50}/H$ 、 $\dot{V}_{25}/H$ 早期已有损害,并随病变的进展而增加。上述三组的DL<sub>CO</sub>及K<sub>CO</sub>均低于正常,且有较高的异常检出率,其中尤以K<sub>CO</sub>值更为敏感。弥散功能的降低可早于胸部X线异常的出现。呼吸功能测定可作为铍作业工人预防性监测和铍病劳动能力鉴定的重要依据。

**关键词** 铍病 弥散功能 血气分析

铍病是主要侵犯呼吸器官的一种全身性疾病。有关铍病的呼吸功能改变,国内尚未见系统报告。本文测定并分析了31例铍病和可疑铍病患者的多项呼吸功能指标,包括肺量图肺功、残气、弥散、小气道功能和血气分析等,并与铍接触者进行对照,现将结果报道如下。

## 对象与方法

### 一、检查对象

全部对象均为我院住院患者,除1例为女性外,均为男性。平均年龄 $42.5 \pm 6.2$  (24~58)岁。铍作业工龄3月~22年。工种包括铍冶炼、铍金属及合金加工、高温陶瓷制品的制作。主要接触金属铍、氧化铍和氢氧化铍。根据胸部X线所见分为3组:①铍病接触组:共10例。X线胸片正常或基本正常。②可疑铍病组:共19例。X线胸片表现为肺纹理增重,扭曲变形,并出现较多的网状阴影。个别病例可见到局限的少数细小的圆形或类圆形阴影。③铍病组:共12例。X线胸片示广泛的肺纹理增强,有较多的网状阴影及散在的细小的圆形或类圆形阴影。

### 二、测试项目

肺功能系采用Chest35F型肺功能仪进行测定。项目包括肺活量(VC)、用力肺活量(FVC)、第一秒时间肺活量(FEV<sub>1</sub>)、第一秒时间肺活量占用力肺活量比值(FEV<sub>1</sub>/FVC%)、功能残气量(FRC)、残气(RV)、最大呼气中期流速(MMEF)、肺总量(TLC),以及以身高标化的50%肺活量最大呼气流量( $\dot{V}_{50}/H$ )和25%肺活量最大呼气流量( $\dot{V}_{25}/H$ )。一氧化

碳弥散量(DL<sub>CO</sub>)及弥散常数(K<sub>CO</sub>)。

血气分析系采取“动脉化”耳垂血,然后用Radiometer ABL Ⅲ型血气分析仪测定。项目包括氧分压(PaO<sub>2</sub>)、二氧化碳分压(PaCO<sub>2</sub>)、血氧饱和度(SaO<sub>2</sub>)、血液酸碱度(pH)、实际碳酸氢(ABC)、剩余碱(ABE)。

### 三、计算方法

为便于统一分析对比,去除性别、年龄、身高、体重等影响,本文绝大部分指标均采用实测值占预计值的百分比来表示。除RV和RV/TLC的实测值高于预计值20%判为异常外,其余各项指标均以实测值小于预计值80%作为判定异常的界限。血气分析指标,若PaO<sub>2</sub><10.7kPa(80mmHg),SaO<sub>2</sub><94%,PaCO<sub>2</sub>>5.3kPa(40mmHg),pH>7.50则判为异常。计算得出上述3组中各项指标的均数及标准差,并逐项进行显著性测验,以及计算出各个指标的异常检出率(A.T.R.)。

## 结 果

各组测得的主要肺功能指标和血气分析指标的检测结果( $\bar{X} \pm SD$ )及异常检出率(A.T.R.)见表1,表2,表3。

测定结果:①铍接触组和可疑铍病组的VC、FVC、RV、RV/TLC比值相差不大,差异无显著性(P>0.05);而铍病组的上述指标则明显降低,与其他两组比较,差异非常显著(P<0.01),并且有较高的异常检出率。②铍接触组的FEV<sub>1</sub>/FVC比值在正常范围,而可疑铍病组与铍病组则有不同程度的降低,铍

表1 通气功能及肺容量检测结果及异常检出率

|                  | VC(%)        | FVC(%)       | FEV <sub>1</sub> /FVC(%) | RV(%)        | RV/TLC(%)  |
|------------------|--------------|--------------|--------------------------|--------------|------------|
| 敏接触<br>(n=10)    |              |              |                          |              |            |
| $\bar{X} \pm SD$ | 103.2 ± 22.1 | 103.8 ± 15.4 | 86.2 ± 10.3              | 104.4 ± 6.5  | 30.8 ± 3.6 |
| A.T.R            | 0            | 0            | 10.0%                    | 0            | 0          |
| 可疑敏病<br>(n=19)   |              |              |                          |              |            |
| $\bar{X} \pm SD$ | 102.8 ± 16.7 | 103.7 ± 11.8 | 78.6 ± 14.5              | 106.8 ± 10.3 | 32.0 ± 2.9 |
| A.T.R            | 10.5%        | 15.6%        | 26.3%                    | 15.6%        | 15.6%      |
| 敏病<br>(n=12)     |              |              |                          |              |            |
| $\bar{X} \pm SD$ | 94.5 ± 19.6  | 95.6 ± 12.5  | 76.3 ± 12.6              | 116.5 ± 8.8  | 37.1 ± 3.8 |
| A.T.R            | 41.7%        | 41.7%        | 58.3%                    | 50.0%        | 50.0%      |

表2 小气道功能及弥散功能检测结果及异常检出率

|                  | MMEF(%)     | $\dot{V}_{50}/H(\%)$ | $\dot{V}_{25}/H(\%)$ | DLco(%)     | Kco(ml/mmHg/min/L) |
|------------------|-------------|----------------------|----------------------|-------------|--------------------|
| 敏接触<br>(n=10)    |             |                      |                      |             |                    |
| $\bar{X} \pm SD$ | 96.5 ± 10.3 | 92.0 ± 12.8          | 86.2 ± 15.8          | 78.3 ± 16.7 | 4.51 ± 1.90        |
| A.T.R            | 20.0%       | 20.0%                | 30.0%                | 20.0%       | 40.0%              |
| 可疑敏病<br>(n=19)   |             |                      |                      |             |                    |
| $\bar{X} \pm SD$ | 87.6 ± 14.2 | 70.2 ± 19.7          | 74.6 ± 17.3          | 68.2 ± 14.2 | 4.16 ± 1.1         |
| A.T.R            | 15.6%       | 21.1%                | 26.3%                | 36.8%       | 47.4%              |
| 敏病<br>(n=12)     |             |                      |                      |             |                    |
| $\bar{X} \pm SD$ | 60.4 ± 12.7 | 52.4 ± 16.3          | 66.5 ± 14.6          | 60.4 ± 19.5 | 3.46 ± 0.9         |
| A.T.R            | 58.3%       | 66.7%                | 66.7%                | 75.0%       | 100.0%             |

表3 血气分析结果及异常检出率

|                  | PaO <sub>2</sub> (mmHg) | PaCO <sub>2</sub> (mmHg) | SatO <sub>2</sub> (%) | pH          |
|------------------|-------------------------|--------------------------|-----------------------|-------------|
| 敏接触<br>(n=10)    |                         |                          |                       |             |
| $\bar{X} \pm SD$ | 96.12 ± 12.73           | 40.6 ± 5.64              | 96.20 ± 1.80          | 7.43 ± 0.05 |
| A.T.R            | 0                       | 0                        | 0                     | 0           |
| 可疑敏病<br>(n=7)    |                         |                          |                       |             |
| $\bar{X} \pm SD$ | 85.22 ± 12.25           | 38.57 ± 7.41             | 95.16 ± 2.70          | 7.43 ± 0.04 |
| A.T.R            | 0                       | 0                        | 0                     | 0           |
| 敏病<br>(n=8)      |                         |                          |                       |             |
| $\bar{X} \pm SD$ | 82.45 ± 11.82           | 38.41 ± 5.32             | 93.73 ± 2.14          | 7.44 ± 0.04 |
| A.T.R            | 16.7%                   | 0                        | 16.7%                 | 0           |

病组与铍接触组比较,有显著差异( $P < 0.05$ )。铍病组及可疑铍病组的异常检出率分别达58.3%及26.3%。③铍接触组  $MMEF$ 、 $\dot{V}_{50}/H$ 、 $\dot{V}_{75}/H$  比值正常,但异常检出率分别达20.0%及30.0%。可疑铍病组及铍病组比值明显低于正常,与铍接触组有非常显著的差异( $P < 0.01$ )。相应的异常检出率也明显增加。④各组的  $DL_{CO}$  和  $K_{CO}$  检测结果,均低于正常。铍病组、可疑铍病组和铍接触组之间均有非常显著差异( $P < 0.01$ )。另外各组均有较高的异常检出率,特别是  $K_{CO}$  分别为40.0%、47.4%和100.0%。⑤血气分析结果,除铍病组  $PaO_2$  轻度降低,与铍接触组有显著差异( $P < 0.05$ )外,  $SaO_2$ 、 $PaCO_2$ 、 $pH$  在各组之间均无显著差异( $P > 0.05$ )。

## 讨 论

铍是一种毒性较高的金属,长期接触可对呼吸系统产生明显的损害,最终可导致铍病的形成。根据本文的结果表明,长期接触铍可引起呼吸功能的一系列改变。测定结果发现铍接触组和可疑铍病组的  $VC$ 、 $FVC$ 、 $RV$  和  $RV/TLC$  均在正常范围,两组之间无显著差异,说明接触铍而胸部X线未出现改变或出现轻度改变时,肺容量的改变是不明显的,但可疑铍病组  $FEV_1/FVC$  已轻度减低,并与铍接触组有显著差异( $P < 0.05$ ),说明此时气道的损伤增加。而铍病组除  $FEV_1/FVC$  明显减低外,由于肺部广泛的肉芽肿、纤维化和肺气肿,肺的弹性减低,因而肺容量也相应地减少,残气增加,从肺功能损害类型来看,属阻塞和限制并存的混合型损害。铍可损伤小气道。铍接触组  $MMEF$ 、 $\dot{V}_{50}/H$  和  $\dot{V}_{75}/H$  值虽属正常范围,但异常检出率已分别达20.0~30.0%,且可疑铍病组及铍肺组与铍接触组比较均有显著及非常显著差异,异常检出率也明显增加,说明铍对小气道的损伤不仅出现较早,而且也较广泛。

本文结果表明铍作业工人最早出现和最突出的肺功能异常为  $DL_{CO}$  和  $K_{CO}$  降低。 $DL_{CO}$  和  $K_{CO}$  值在3组之间呈依次降低,并有显著差

异。特别是胸部X线未发现异常的铍接触组,分别已有20.0%和40.0%的异常检出率。上述两指标在可疑铍肺组又进一步降低,异常检出率增加。而铍病组的  $K_{CO}$  异常检出率竟高达100%,  $DL_{CO}$  达75.0%。由于  $DL_{CO}$  是反映肺内气体弥散功能的一项综合性指标,而  $K_{CO}$  则是用  $DL_{CO}$  除以肺泡总面积而得到的反映肺各功能单位平均气体传送能力大小的指标,由于其考虑了肺泡容量的影响,因而反映早期弥散功能异常的灵敏度高于  $DL_{CO}$ <sup>(1)</sup>。已知肺泡壁破坏,肺间质纤维化,以及肺毛细血管床的减少导致气体交换面积的减少,是产生弥散功能降低的主要原因<sup>(2)</sup>。考虑到铍接触组尽管胸部X线尚未发现异常,但小气道已有一定程度的损伤,由于小气道管壁的痉挛和萎陷,促使吸入气在肺泡气中的不均等分布,我们认为这可能也是早期造成弥散功能低下的原因之一。

本文在测定肺功能的同时,进行了血气分析的测定,结果发现除铍病组的  $PaO_2$  均值低于铍接触组,差异有显著性,以及其中有2例显示低氧血症外,各组  $PaCO_2$ 、 $SaO_2$  及  $pH$  均无显著差异,这说明尽管弥散功能已有降低,但尚未达到足以产生明显的低氧血症、高碳酸血症,以及导致血液酸碱平衡的失调。

综上所述,鉴于长期接触铍后可产生呼吸功能的一系列改变,因此我们认为肺功能测定可作为铍作业工人预防性监测和铍病劳动能力鉴定的重要依据。在各项指标中以  $K_{CO}$  和  $DL_{CO}$  最为敏感。对在短期内  $K_{CO}$  和  $DL_{CO}$  持续降低的铍作业工人,即使胸部X线未发现异常,也应当停止接触铍,以有利于保护铍作业工人的健康,预防铍病的发生。

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## Abstracts of Original Articles

### Clinical Manifestations and Diagnosis of Acute Pyrethroids Poisoning

He Fengsheng, et al,

Acute pyrethroids poisoning in human has not been reported outside China. This article gives a review of 573 cases of acute pyrethroid poisoning gathered from Chinese medical literature during the period 1982~1988.

Among the 573 cases, there were 229 cases of occupational poisoning and 344 of accidental poisoning. Acute deltamethrin poisoning was most frequently encountered (325 cases), followed by acute fenvalerate poisoning (196 cases) and acute cypermethrin poisoning (45 cases). The various clinical aspects including onset, symptoms, signs, laboratory tests and outcome are described and analysed. The diagnosis, gradation and differential diagnosis are discussed aiming at drawing up of a diagnostic criterion for the acute pyrethroids poisoning

Key words: pyrethroids deltamethrin poisoning

### Study on Occupational Risk in the Pleurotus Growing Process

Wen Baoyuan, et al,

Labour hygiene investigations, clinical examinations, immunology test, culture of moulds and animal experiments have been done in 36 pleurotus growing on-the-spots in 377 pleurotus workers. These studies confirm that occupational respiratory disease in the pleurotus workers as a result of inhaling basidiospores of pleurotus sapidus, bear no relation to the spores of thermophilic actinomycetes including thermoactinomyces vulgaris and micro-

polyspora fungi etc in the process of growing pleurotuses which are cultivated making use of cottonseed skins. Clinical rule and characteristics of the disease were described. The authors suggest that diagnosis fall under hypersensitivity bronchitis due to pleurotus florida and allergic alveolitis (mushroom worker's lung).

Key words: pleurotus mushroom worker's lung exogenous allergic alveolitis

### Measurement and Analysis of Lung Function in Berylliosis

Shi Zhicheng, et al,

The lung function of 12 berylliosis cases, 19 suspected cases and 10 cases exposed to beryllium was measured. The results showed that VC, FVC, RV, RV/TLC were normal in suspected cases as well as in cases exposed to beryllium.  $FEV_1/FVC$  was decreased in suspected cases, but RV, RV/TLC were increased and VC, FVC,  $FEV_1/FVC$  were decreased in berylliosis cases. They had great significance between berylliosis cases and cases exposed to beryllium ( $P < 0.01$ ). MMEF,  $\dot{V}_{1.0}/H$ ,  $\dot{V}_{1.5}/H$  were progressively damaged.

DLco and Kco were decreased even in cases exposed to beryllium, especially Kco was more sensitive. It demonstrated that the decrease of diffusion capacity might be produced earlier than the appearance of abnormal manifestation in chest X-ray film.

The measurement of lung function can be recommended as occupational health preventive surveillance of beryllium workers and important basis for compensation of berylliosis.

Key words: berylliosis diffusion capacity blood gas analysis