

## 荷负电气溶胶治疗 II 度烧伤创面的临床效果及病理学观察

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**【摘要】** 目的 观察荷负电气溶胶(下称气溶胶)治疗 II 度烧伤创面的效果。方法 选择单纯浅 II、深 II 度烧伤患者,随机分为:(1)气溶胶组:浅 II 度 180 例、深 II 度 100 例,伤后 6 h~2 d 开始用气溶胶治疗创面,1~2 次/d,1.5 h/次。(2)对照组:浅 II、深 II 度患者各 30 例,常规治疗。(3)自身对照组:浅 II、深 II 度患者各 10 例,同上用气溶胶治疗,但同一患者部分创面覆盖无菌金属片屏蔽气溶胶(屏蔽组),部分创面不屏蔽(非屏蔽组)。观察气溶胶治疗过程中患者创面的大体变化,治疗前后进行创面细菌培养,并监测其肝、肾功能及血生化指标有无改变。记录各组患者创面愈合时间。另制作深 II 度烫伤大鼠模型,同前分为气溶胶组和对照组并治疗。取两组大鼠治疗前及治疗后 1、2、3 周的创面组织标本,作病理学观察。结果 气溶胶治疗后患者创面渗出少,治疗前后均无细菌生长。总体来讲,气溶胶治疗前后患者肝、肾功能及血生化指标无明显改变。气溶胶组患者浅 II 度创面伤后(6.3±1.6)d 愈合,深 II 度创面(15.1±3.1)d 愈合,明显短于对照组相同深度创面[(11.3±1.4)、(21.2±1.4)d,  $P < 0.01$ ]。自身对照组中,相同烧伤深度的非屏蔽组与屏蔽组比较,创面愈合时间也明显缩短( $P < 0.01$ )。病理学检查显示,气溶胶组大鼠治疗后第 3 周皮肤结构已基本恢复正常,而对照组此时恢复较差。结论 气溶胶能有效促进 II 度烧伤创面的愈合且使用安全。

**【关键词】** 烧伤; 荷负电气溶胶; 创面愈合

**Clinical study and pathological examination on the treatment of deep partial thickness burn wound with negative charge aerosol** LI Tian-zeng\*, XU Ying-bin, HU Xiao-gen, SHEN Rui, PENG Xiao-dong, WU Wei-jiang, LUO Lan, DAI Xin-ming, ZOU Yong-tong, QI Shao-hai, WU Li-ping, XIE Ju-lin, DENG Xiao-xin, CHEN E, ZHANG Hui-zhen. \*Department of Burns, First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, P. R. China

**【Abstract】** Objective To investigate the effect of negative charge aerosol (NCA) on the treatment of burn wound. Methods Patients with superficial or deep partial thickness burn only were enrolled in the study, and they were randomly divided into trial group (T, including 180 cases of superficial thickness burn and 100 cases of deep partial thickness burn), control group (C, including 30 cases with superficial thickness burn and 30 with deep partial thickness burn), and self control group (SC, including 10 cases with superficial thickness burn and 10 with deep partial thickness burn). The patients in T and SC groups were treated with NCA for 1.5 hours, 1~2 times a day, from 6 postburn hour (PBH) to 2 postburn day (PBD), while those in C group received conventional treatment. For those in SC group, some of the wounds were covered with sterile scissel, while other wounds without scissel covering. The general changes in the wounds during NCA treatment were observed, and bacterial culture before and after NCA treatment was performed. The healing time was recorded and the blood biochemical parameters were determined. Rat model with deep partial thickness scald was established, and the rats were also divided into T and C groups, and received treatment as in human. Tissue samples were harvested from the wounds of rats in the 2 groups before and 1, 2, 3 weeks after treatment for pathological examination. Results There was no infection and little exudation in the patients in T group. No bacteria were found in the wound before and after NCA treatment. The healing time of the wounds of patients with superficial and deep partial thickness burn in T group was 6.3±1.6 d and 15.1±3.1 d, respectively, which was obviously shorter than those in C group (11.3±1.4 d and 21.2±1.4 d,  $P < 0.01$ ). In SC group, the healing time of those with sterile scissel coverage was also significantly shorter than those without covering ( $P < 0.01$ ). There was no obvious change in the liver and kidney functions and blood biochemical parameters among the patients. Pathological examination showed that the skin structure was almost recovered in the rats in T group 3 weeks after treatment, while those in C

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group was not. **Conclusion** Negative charge aerosol is safe and effective in promoting wound healing of the patients with partial thickness burns.

**【Key words】** Burns; Negative charge aerosol; Wound healing

烧伤创面存在时间的长短直接影响患者的病情,如何促进创面愈合是近年来研究的热点<sup>[1-3]</sup>。笔者以往用大鼠烫伤模型进行实验,观察到荷负电气溶胶[下称气溶胶(aerosol)]能促进Ⅱ度烫伤创面的愈合,治疗后大鼠创面组织中胰岛素样生长因子Ⅰ(IGF-Ⅰ)mRNA、胰岛素样生长因子结合蛋白53(IGFBP53)mRNA、血小板源性生长因子(PDGF)、血小板源性生长因子受体 $\alpha$ 、 $\beta$ (PDGFR- $\alpha$ , $\beta$ )的表达水平及Ⅰ型胶原的含量均明显增多,并能促进创面残存的表皮干细胞增生。这些改变可能是气溶胶促进创面愈合的部分原因(另文发表)。为探讨该项治疗措施的临床应用价值,笔者进行了以下研究。

## 资料与方法

### 一、临床观察

1. 临床资料:本组患者360例,其中男220例、女140例。年龄8个月~83岁[(48±10)岁]。热液烫伤283例,火焰烫伤67例(含电火花烧伤9例),摩托车排气管烫伤7例,化学烧伤3例。浅Ⅱ度220例,深Ⅱ度140例,烧伤总面积1%~92%[(30±15)%]TBSA。

2. 研究分组及治疗方法:所有患者的创面都在清创后用100 g/g碘伏软膏纱布覆盖,进行半暴露治疗,每天换药1次。按随机分配原则将患者分为3组:(1)气溶胶组:其中浅Ⅱ度180例、深Ⅱ度100例,均用气溶胶治疗,1~2次/d,1.5 h/次。SQ365型荷负电气溶胶发生器由珠海科燃生物工程设备有限公司提供。(2)对照组:浅Ⅱ度、深Ⅱ度各30例,不加气溶胶而作常规治疗。(3)自身对照组:浅Ⅱ度10例,同前法用气溶胶治疗,但同一患者部分创面覆盖无菌金属片屏蔽气溶胶(屏蔽组)、部分创面不屏蔽气溶胶(非屏蔽组);深Ⅱ度10例,同上分为屏蔽组与非屏蔽组。患者开始用气溶胶治疗的时间为伤后6 h~2 d。

3. 观察指标:观察气溶胶治疗过程中患者创面的大体变化,治疗前后进行创面细菌培养,并检测其治疗前后肝、肾功能及血生化指标有无改变。记录各组患者创面愈合时间。

### 二、病理学观察

1. 动物模型及分组:取20只Wistar大鼠(中山大学实验动物中心),制成深Ⅱ度烫伤(经病理切片

证实,以下称烧伤)模型后,分为气溶胶组和对照组各10只,治疗方法同前述临床观察中的同名组别。

2. 观察指标:取两组大鼠治疗前及治疗后1、2、3周的创面组织标本,进行链霉素和素-生物素(SAB)免疫组织化学染色,作病理学观察。

### 三、统计学处理

数据以 $\bar{x} \pm s$ 表示,行单因素方差分析及 $t$ 检验。

## 结果

1. 患者创面大体变化:(1)气溶胶治疗1.5 h后患者创面渗出少,较干燥,表面形成一层淡黄色薄膜。随后上皮细胞生长迅速,浅Ⅱ度创面治疗6 d左右角化;深Ⅱ度创面可见从毛囊、汗腺处长出的小皮岛,日渐扩大,彼此融合,最终创面得以修复。(2)典型病例:患儿男,2岁。右前臂浅Ⅱ度烫伤,面积1.5%TBSA(图1)。伤后14 h入院,随即用气溶胶治疗。治疗过程中可见创面清洁、干燥(图2)。治疗至第4天,创面开始痂下愈合(图3),第5天时完全愈合。1周后复查,愈合部位皮肤光滑平整(图4)。



图1 气溶胶治疗前的浅Ⅱ度烫伤创面  
Fig 1 Child with superficial second degree burn



图2 气溶胶治疗后46 h,创面清洁、干燥  
Fig 2 The wound was clean and dry 46 hours after NCA treatment



图3 气溶胶治疗第4天,创面开始痂下愈合  
Fig 3 The wound was healed subeschar 4 days after NCA treatment



图4 创面愈合后1周可见皮肤光滑平整  
Fig 4 The skin was smooth and plain 1 week after wound healing

2. 创面细菌培养结果:气溶胶治疗前后患者创面均无细菌生长。

3. 肝、肾功能及血生化指标:除烧伤总面积92% TBSA的1例患者伤后早期肝、肾功能有改变,但随着治疗时间的延长逐渐恢复外,其余经气溶胶治疗的患者治疗前后以上指标无明显异常。

4. 各组患者创面愈合时间:见表1。

表1 各组患者的创面愈合时间( $\bar{x} \pm s$ )

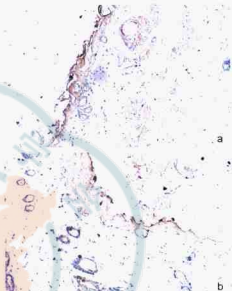
Tab 1 The mean healing time of the wound in each group( $\bar{x} \pm s$ )

组别	例数	创面愈合时间(d)
气溶胶组		
浅Ⅱ度创面	180	6.3 ± 1.6*
深Ⅱ度创面	100	15.1 ± 3.1*
对照组		
浅Ⅱ度创面	30	11.3 ± 1.4
深Ⅱ度创面	30	21.2 ± 1.4
自身对照组		
浅Ⅱ度创面	10	
非屏蔽组		7.3 ± 1.1*
屏蔽组		12.3 ± 1.2
深Ⅱ度创面	10	
非屏蔽组		15.8 ± 3.1*
屏蔽组		20.8 ± 2.2

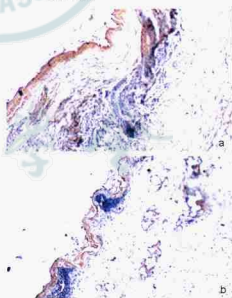
注:气溶胶组与对照组相同深度创面比较,\* $P < 0.01$ ;非屏蔽组与相同深度创面屏蔽组比较,\* $P < 0.01$

5. 病理学观察:深Ⅱ度烧伤大鼠伤后创面表皮、部分真皮、皮肤附件的正常结构明显受损。治疗1

周时,气溶胶组大鼠表皮基底层结构已大部分恢复(图5a),对照组恢复较差(图5b)。治疗第2周,气溶胶组表皮层明显增厚,对照组表皮增生较慢。第3周时,气溶胶组皮肤结构已基本恢复正常(图6a),对照组创面恢复欠佳(图6b)。



注:a.气溶胶组表皮基底层结构已大部分恢复正常;b.对照组表皮基底层结构恢复较差  
图5 两组大鼠治疗第1周时创面组织病理学观察 LSAB × 200  
Fig 5 Pathological examination of the wound of the rats in the two groups 1 week after NCA treatment - LSAB × 200



注:a.气溶胶组皮肤结构基本恢复正常;b.对照组皮肤结构恢复欠佳  
图6 两组大鼠治疗第3周时创面组织病理学观察 LSAB × 200  
Fig 6 Pathological examination of the wound in the two groups of the rats 3 weeks after NCA treatment - LSAB × 200

周时,气溶胶组大鼠表皮基底层结构已大部分恢复(图5a),对照组恢复较差(图5b)。治疗第2周,气溶胶组表皮层明显增厚,对照组表皮增生较慢。第3周时,气溶胶组皮肤结构已基本恢复正常(图6a),对照组创面恢复欠佳(图6b)。

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