

H-UPPP 联合低温等离子舌根射频消融术对 OSAHS 患者血氧饱和度及动脉血氧分压的影响

王桂芳, 李仁高, 马青

中国人民解放军联勤保障部队第 926 医院 耳鼻咽喉科, 云南 开远 661600

摘要: **目的** 探讨改良悬雍垂腭咽成形术(han-uvulopalatopharyngoplasty, H-UPPP)联合低温等离子舌根射频消融术对阻塞性睡眠呼吸暂停低通气综合征(obstructive sleep apnea hypopnea syndrome, OSAHS)患者血氧饱和度及动脉血氧分压(arterial partial pressure of oxygen, PaO₂)的影响。**方法** 选取 OSAHS 患者 72 例,根据手术方式将其分为 H-UPPP 手术组(采用单一 H-UPPP 治疗)和联合手术组(采用 H-UPPP 联合低温等离子舌根射频消融术治疗),有 2 例失访,最终 70 例纳入本研究,其中 H-UPPP 手术组 35 例,联合手术组 35 例;比较两组术前和术后 6 个月低通气指数(apnea hypopnea index, AHI)、最低血氧饱和度(lowest oxygen saturation, LSaO₂)、PaO₂、动脉血二氧化碳分压(arterial partial pressure of carbon dioxide, PaCO₂)、用力肺活量、第 1 秒用力呼气容量、Epworth 嗜睡量表(epworth sleepiness scale, ESS)评分及模拟视觉量表(visual analogue scale, VAS)评分,观察两组临床疗效及术后不良反应。**结果** 术后 6 个月,联合手术组和 H-UPPP 手术组 AHI 和 PaCO₂ 较术前均降低,LSaO₂、PaO₂ 均增加(P 均 <0.05),联合手术组 AHI 低于 H-UPPP 手术组,LSaO₂、PaO₂ 高于 H-UPPP 手术组($P=0.036$ 、 0.030 、 0.001),但组间 PaCO₂ 比较差异无统计学意义($P=0.737$);联合手术组和 H-UPPP 手术组用力肺活量、第 1 秒用力呼气容量较术前均增加(P 均 <0.05),联合手术组用力肺活量、第 1 秒用力呼气容量均大于 H-UPPP 手术组(P 均 <0.001);两组 ESS 评分均降低,VAS 评分均升高,联合手术组 ESS 评分低于 H-UPPP 手术组,VAS 评分高于 H-UPPP 手术组。联合手术组治疗总有效率高于 H-UPPP 手术组($P=0.025$);两组术后并发症总发生率比较,差异均无统计学意义($P=0.353$)。**结论** H-UPPP 联合低温等离子舌根射频消融术可有效促进 OSAHS 患者肺功能恢复,改善 LSaO₂、PaCO₂ 及 PaO₂,临床疗效较好,安全性较佳。

关键词: 腭咽成形术;射频消融术;舌;阻塞性睡眠呼吸暂停低通气综合征;肺功能;血氧饱和度;动脉血氧分压

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Effects of H-UPPP combined with radiofrequency ablation of tongue root with low temperature plasma on oxygen saturation and arterial oxygen partial pressure in patients with OSAHS

WANG Guifang, LI Rengao, MA Qing

Department of Otorhinolaryngology, No. 926 Hospital, Joint Logistics Support Force of the People's Liberation Army of China, Kaiyuan 661600, Yunnan, China

Abstract: Objective To explore the effect of han-uvulopalatopharyngoplasty (H-UPPP) combined with radiofrequency ablation of tongue root at low temperature on oxygen saturation and arterial partial pressure of oxygen (PaO₂) in patients with obstructive sleep apnea hypopnea syndrome (OSAHS). **Methods** Seventy-two patients with OSAHS were selected. They were divided into H-UPPP operation group (treated with single H-UPPP) and combined operation group (treated with H-UPPP combined with low-temperature plasma radiofrequency ablation of tongue root) according to the operation methods. Two patients were lost to follow-up, and finally 70 patients were included in this study. There were 35 patients in H-UPPP operation group and 35 patients in combined operation group. The apnea hypopnea index (AHI), low est oxygen saturation (LSaO₂), PaO₂, arterial partial pressure of carbon dioxide (PaCO₂), forced vital capacity, forced expiratory volume in the first second, Epworth sleepiness scale (ESS) and visual analogue scale (VAS) were compared between the two groups before and 6 months after operation. The clinical efficacy and postoperative adverse reactions of the two groups were observed. **Results** Six months after operation, AHI and PaCO₂ in the combined operation group and H-UPPP operation group decreased compared with that before operation, while LSaO₂ and PaO₂ increased (all $P<0.05$).

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通信作者:王桂芳. E-mail:kangd679@163.com

The AHI of combined operation group was lower than that of H-UPPP operation group, and $LSaO_2$, PaO_2 were higher than that of H-UPPP operation group ($P=0.036, 0.030, 0.001$). But there was no significant difference in $PaCO_2$ between the two groups at six months after operation ($P=0.737$). The forced vital capacity and forced expiratory volume in the first second in the combined operation group and H-UPPP operation group were higher than those before operation (all $P<0.05$). The forced vital capacity and forced expiratory volume in the combined operation group were higher than those in the H-UPPP operation group (all $P<0.001$). The ESS score decreased and the VAS score increased in both groups. The ESS score of combined operation group was lower than that of H-UPPP operation group, and the VAS score was higher than that of H-UPPP operation group. The total effective rate of the combined operation group was higher than that of the H-UPPP operation group ($P=0.025$). There was no significant difference in the total incidence of postoperative complications between the two groups ($P=0.353$). **Conclusion** H-UPPP combined with radiofrequency ablation of tongue root with low temperature plasma can effectively promote the recovery of lung function and improve $LSaO_2$, $PaCO_2$, and PaO_2 in patients with OSAHS, with good clinical efficacy and safety.

Key words: Uvulopalatopharyngoplasty; Ablation techniques; Tongue; Obstructive sleep apnea hypopnea syndrome; Lung function; Oxygen saturation; Arterial partial pressure of oxygen

阻塞性睡眠呼吸暂停低通气综合征 (obstructive sleep apnea hypopnea syndrome, OSAHS) 是一种睡眠呼吸障碍, 临床主要表现为睡眠时上气道塌陷, 并伴有呼吸困难, 严重时可导致糖尿病、冠心病、高血压等多器官系统损害^[1-2], 且其发病率逐年增加^[3]。改良悬雍垂腭咽成形术 (han-uvulopalatopharyngoplasty, H-UPPP) 为当前 OSAHS 常用手术方法, 其对单纯口咽部阻塞患者具有良好效果^[4]。但 OSAHS 常伴有上气道多平面阻塞、舌根后坠、舌体肥厚, 而 H-UPPP 对 OSAHS 伴有舌根阻塞患者疗效欠佳^[5]。近年来, 临床上联合运用 H-UPPP 和低温等离子舌根射频消融术能较好改善舌根阻塞, 取得良好治疗效果^[6]。基于此, 本研究分析 H-UPPP 联合低温等离子舌根射频消融术治疗 OSAHS 患者, 以探讨其对 OSAHS 患者血氧饱和度及动脉血氧分压 (arterial partial pressure of oxygen, PaO_2) 的影响。

1 资料与方法

1.1 一般资料

选取 2020 年 12 月至 2022 年 12 月我院收治的 OSAHS 患者 72 例, 根据手术方式将其分为 H-UPPP 手术组和联合手术组, 有 2 例失访, 最终有 70 例纳入本研究, 其中 H-UPPP 手术组 35 例, 联合手术组 35 例。本研究已经医院医学伦理委员会审核批准 (2023-004)。

纳入标准: ①符合 OSAHS 相关诊断标准^[7], 且病情判定为中、重度, 即低通气指数 (apnea hypopnea index, AHI) ≥ 15 次/h, 最低血氧饱和度 (lowest oxygen saturation, $LSaO_2$) $\leq 85\%$; ②临床及随访资料完整; ③合并舌咽平面阻塞, Friedman 分型为 II 型或 III 型; ④患者及其家属均对本研究知情同意。

排除标准: ①合并精神系统疾病; ②合并心、肝、肾等重要器官功能障碍者; ③近期发生过上呼吸道感染; ④慢阻肺、哮喘等其他呼吸系统疾病者; ⑤伴有颌面畸形或鼻腔通气狭窄; ⑥既往有鼻外伤史; ⑦凝血功能障碍者; ⑧既往有相关外科治疗史的 OSAHS 者。

1.2 方法及观察指标

1.2.1 方法

采用多导睡眠监测仪 (Alice PDX, 飞利浦, 荷兰) 检测两组患者 AHI、 $LSaO_2$ 。所有患者均在术前 1 周进行 Auto-set 整夜持续正压通气治疗。

H-UPPP 手术组行 H-UPPP 治疗: 行全麻, 低温等离子射频手术系统 (美国 Arthrocare 公司, ENTec-Coblator II), 刀头: Evac70, 3~4 档止血, 切割 7~8 档能量。暴露口咽腔, 切除双侧扁桃体, 两弓修剪 (腭舌弓、腭咽弓), 并将其缝合固定于咽侧壁肌层, 扩充咽腔径。腭咽弓切除量据咽后壁黏膜松弛度评估。于悬雍垂两侧, 将软腭口咽侧黏膜切除, 切口呈倒 U 形; 消融腭帆间隙脂肪组织, 重建悬雍垂。

联合手术组行 H-UPPP 联合低温等离子舌根射频消融术治疗: 行全麻, H-UPPP 手术步骤均与上述一致。低温等离子舌根射频消融术: 更换刀头, 调至 5 档, 卵圆钳将舌体中央夹住, 拉至口外; 两舌侧缘及舌根轮廓乳头尖中线区为治疗点, 打 4 个孔, 10 mm 左右孔间距, 每孔消融 15 s。若出血, 以八字缝扎止血。

术后处理及随访: 术后给予抗生素、护胃、止血及消肿等药物治疗; 嘱患者经常漱口, 避免刺激性食物, 术后 1 周出院。出院 2 周后复诊, 术后 6 个月复查。

1.2.2 观察指标

临床指标: 比较两组术前、术后 6 个月 AHI、 $PaCO_2$ 、 $LSaO_2$ 、 PaO_2 。

肺功能指标:比较两组术前、术后 6 个月用力肺活量、第 1 秒用力呼气容量。

疗效指标^[7]:AHI<5 次/h,治愈;AHI<20 次/h,且下降程度在 50% 以上,显效;AHI 下降程度在 50% 以上,有效。治疗总有效率=(治愈+显效+有效)例数/总例数×100%。

睡眠指标:比较两组术前、术后 6 个月日间嗜睡、生活质量改善情况;Epworth 嗜睡量表(Epworth sleepiness scale, ESS)^[8]评估两组日间嗜睡情况,包括 8 个项目,每个项目 0~3 分,总分 0~24 分,分值越高,患者日间嗜睡情况越严重;分别于术前、术后 6 个月采用模拟视觉量表(visual-analogue scale, VAS)^[9]评估两组患者生活质量改善情况,总分 0~10 分,分值越高,生活质量改善越明显。

术后并发症:统计两组术后切口出血、咽部异物感及鼻腔反流发生情况。

1.3 统计学处理

采用 SPSS 25.0 软件,符合正态分布的计量资料以 $\bar{x}\pm s$ 表示,年龄、病程等比较采用 t 检验;计数资料以 $n(\%)$ 表示,性别构成比、Friedman 分型等比较采用 χ^2 检验或校正 χ^2 检验,检验水准 $\alpha = 0.05$ 。

2 结果

2.1 一般资料

两组一般资料比较,差异无统计学意义($P > 0.05$)。见表 1。

表 1 两组一般资料比较
Table 1 Comparison of two groups of general data

组别	性别		年龄/岁	病程/年	BMI(kg/m ²)	Friedman 分型	
	男/例	女/例				II 型/例	III 型/例
联合手术组	23	12	45.54±9.01	8.43±2.22	27.56±2.15	10	25
H-UPPP 手术组	22	13	44.77±8.91	8.51±2.15	27.61±2.12	12	23
χ^2/t	0.062		0.359	0.153	0.098	0.265	
P	0.803		0.720	0.879	0.922	0.607	

2.2 临床指标

术后 6 个月,两组 AHI、PaCO₂ 较术前均降低,LSaO₂、PaO₂ 均增加,联合手术组 AHI 更低、LSaO₂

和 PaO₂ 更高($P < 0.05$);但组间 PaCO₂ 比较,差异无统计学意义($P > 0.05$)。见表 2。

表 2 两组临床指标比较
Table 2 Comparison of clinical indexes between two groups

组别	AHI/(次/h)		LSaO ₂ /%		PaO ₂ /mmHg		PaCO ₂ /mmHg	
	术前	术后 6 个月	术前	术后 6 个月	术前	术后 6 个月	术前	术后 6 个月
联合手术组	35.54±9.69	15.83±6.03*	71.37±7.01	79.31±6.28*	62.33±9.21	71.45±6.13*	55.22±8.90	39.78±8.21*
H-UPPP 手术组	36.11±9.60	19.46±8.06*	69.31±6.13	76.17±5.51*	62.14±9.18	66.24±6.08*	55.43±8.65	39.12±8.14*
t	0.247	2.133	1.141	2.224	0.086	3.570	0.100	0.338
P	0.805	0.036	0.258	0.030	0.931	0.001	0.921	0.737

注:与同组术前比较,* $P < 0.05$ 。

2.3 肺功能指标

容量较术前均增加,联合手术组大于 H-UPPP 手术组($P < 0.05$)。见表 3。

表 3 两组肺功能指标比较

Table 3 Comparison of lung function indexes between two groups

组别	用力肺活量/%		第 1 秒用力呼气容量/%	
	术前	术后 6 个月	术前	术后 6 个月
联合手术组(35 例)	88.74±3.47	95.91±4.79*	81.20±3.71	93.66±5.35*
H-UPPP 手术组(35 例)	88.71±3.37	92.34±3.13*	81.26±3.74	88.11±4.01*
t	0.037	3.691	0.067	4.911
P	0.971	<0.001	0.946	<0.001

注:与同组术前比较,* $P < 0.05$ 。

2.4 主观指标:

均升高,联合手术组 ESS 评分低于 H-UPPP 手术组,VAS 评分高于 H-UPPP 手术组。见表 4。

术后 6 个月,两组 ESS 评分均降低,VAS 评分

表 4 两组主观指标比较
Table 4 Comparison of subjective indicators between the two groups

单位:分

组别	ESS 评分		VAS 评分	
	术前	术后 6 个月	术前	术后 6 个月
联合手术组(35 例)	12.33±3.13	4.14±0.72 *	2.19±0.71	7.66±1.04 *
H-UPPP 手术组(35 例)	12.40±3.21	6.18±1.32 *	2.14±0.68	6.71±1.43 *
<i>t</i>	0.092	8.027	0.301	3.179
<i>P</i>	0.927	<0.001	0.764	0.002

注:与同组术前比较,**P*<0.05。

2.5 临床疗效

($\chi^2 = 5.040, P = 0.025$)。见表 5。

联合手术组治疗总有效率高于 H-UPPP 手术组

表 5 两组疗效比较
Table 5 Comparison of efficacy between two groups

单位:例数/例(占比/%)

组别	治愈	显效	有效	无效	总有效
联合手术组(35 例)	2(5.71)	18(51.43)	7(20.00)	8(22.86)	27(77.14)
H-UPPP 手术组(35 例)	0(0)	12(34.29)	6(17.14)	17(48.57)	18(51.43)

2.6 两组术后并发症比较

异($\chi^2 = 0.862, P = 0.353$)。见表 6。

两组术后并发症总发生率差比较,均无显著差

表 6 两组术后并发症比较
Table 6 Comparison of postoperative complications between the two groups

单位:例数/例(占比/%)

组别	切口出血	咽部异物感	鼻腔反流	总发生
联合手术组(35 例)	1(2.86)	0(0)	1(2.86)	4(11.43)
H-UPPP 手术组(35 例)	0(0)	2(5.71)	1(2.86)	1(2.86)

3 讨论

OSAHS 患者上气道狭小,患者在睡眠过程中反复出现上气道塌陷,导致呼吸暂停/呼吸不足,并伴有低氧血症^[10]。该病除可引起或加重呼吸衰竭外,还常合并高血压^[11],对患者预后造成影响。目前,OSAHS 的主要治疗依赖于保守方法,如改善睡眠卫生、减轻体质量及持续气道正压通气治疗等,但部分患者对持续气道正压通气机器不耐受,一般采取替代疗法(手术治疗)。

OSAHS 手术治疗旨在减少由于鼻-口-下咽部软组织过多而造成的气道阻塞效应。H-UPPP 是最常用手术方式,然而,其仅能治疗软腭中阻塞,而对于舌根平面阻塞疗效欠佳^[12]。舌源性 OSAHS 是由舌根淋巴组织增生肥大所致舌根平面阻塞^[13],目前,临床常采用舌骨悬吊及减少舌根容积方案治疗舌根平面阻塞^[14-16]。前者需特殊器械且术中出血多、机体损害大,且术后易发生肿胀、呼吸困难,预后较差^[17]。而舌根射频消融术能较好扩大咽腔径,且具有术野清晰、创伤小、并发症少、恢复快等优点^[18]。随着病情发展,OSAHS 患者鼻腔内会出现不同程度炎症反应,引起黏膜充血肿胀、分泌物增加,随着炎性分泌物流入气道,进而影响患者肺功

能^[19]。此外,OSAHS 还容易引起低氧血症,长期的低氧血症可引发急性呼吸衰竭,甚至死亡。PaO₂、LSaO₂ 是反映肺功能的重要指标。本研究结果显示,治疗后联合手术组用力肺活量、第 1 秒用力呼气容量、LSaO₂ 及 PaO₂ 均高于 H-UPPP 手术组,AHI 低于 H-UPPP 手术组,表明 H-UPPP 联合低温等离子舌根射频消融术能有效改善 OSAHS 患者肺功能及低氧血症。这可能是由于 H-UPPP 能有效矫正鼻腔及咽腔异常结构,减轻气道损伤,降低通气阻力,改善低通气状态,使患者能获得充足氧气;而联合手术组在 H-UPPP 基础上加用低温舌根射频消融术,可在 H-UPPP 手术基础上进一步扩充气道,提高通气功能,进而进一步改善患者肺功能,减少低氧血症发生。

ESS 常被用来评估 OSAHS 患者的嗜睡情况和主观睡眠质量。本研究结果显示,联合治疗能较好改善 OSAHS 患者预后及生活质量,且安全性较好。这与 Sundman 等^[20]的研究结果一致。究其原因因为手术治疗改善患者上气道通气能力、减轻鼻塞,促进机体正常代谢及睡眠结构恢复,进而改善睡眠质量;还有一部分原因可能是患者低氧血症得到有效减轻,也有助于改善嗜睡症状。此外,本研究中联合手术组患者术后未出现咽部异物感,这可能是由于低温等离子舌根射频消融术有明显的组织减容效果,

可显著减少咽部异物感;而出现 1 例切口出血则可能是由于联合手术治疗手术创伤较大,而此例患者在手术过程中未进行彻底止血,导致术后出血。因此,在手术过程中,可通过对术腔彻底止血来有效避免术后出血。

综上,HUPPP 联合低温等离子舌根射频消融术治疗 OSAHS 疗效确切,且可有效改善患者肺功能、 $LSaO_2$ 、 PaO_2 ,减少低氧血症发生,安全性良好。

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