·临床研究·

经鼻高流量氧疗在基于膈肌浅快呼吸指数评估的高风险脱机患者中的应用

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[摘 要] **目的**:探讨经鼻高流量氧疗(high-flow nasal cannula,HNFC)在基于超声测量膈肌浅快呼吸指数(diaphragmatic-rapid shallow breathing index,D-RSBI)评估的高风险脱机拔管患者中的应用价值。**方法**:选取2017年9月—2019年11月南京医科大学附属脑科医院(胸科院区)ICU机械通气大于48 h的患者,在通过自主呼吸试验符合脱机拔管程序基础上,使用超声测量D-RSBI,以D-RSBI≥1.3次/(min·mm)评估为高风险脱机患者,将该类患者随机分为两组:HNFC组和常规氧疗(conventional oxygen therapy,COT)组;比较两组患者拔除气管插管后48 h内再插管率及拔管后6、24、48 h呼吸频率(RR)、心率(HR)、动脉血氧饱和度(SaO_2)、动脉血二氧化碳分压($PaCO_2$)、氧合指数(PaO_2/FiO_2)。**结果**:本研究最终纳入符合入组标准的患者共41例,其中HFNC组21例,COT组20例;拔除气管插管后6、24 h HFNC组RR、HR、SaO_2、PaO_2/FiO_2均优于COT组,差异有统计学意义($P<0.05$),$PaCO_2$两组差异无统计学意义($P>0.05$);拔管后48 h HFNC组SaO_2、PaO_2/FiO_2明显高于COT组($P<0.05$),差异有统计学意义,RR、HR、$PaCO_2$两组差异无统计学意义($P>0.05$)。HNFC组拔管后48 h内再插管率明显低于COT组(4.76% *vs*.30.00%,$P<0.01$)。**结论**:针对基于D-RSBI评估的高风险脱机拔管患者,拔管后使用经鼻高流量氧疗较常规氧疗可以明显改善患者的呼吸及氧合情况,降低再插管率,是一种比较理想的序贯治疗策略。

[关键词] 经鼻高流量氧疗;常规氧疗;膈肌浅快呼吸指数;脱机

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The application of high-flow nasal cannula in high-risk patients of extubation failure assessed by the diaphragmatic-rapid shallow breathing index

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[**Abstract**] **Objective**:To investigate the application value of high-flow nasal cannula (HFNC)in high-risk patients with extubation failure based on the ultrasound-measured diaphragmatic-rapid shallow breathing index (D-RSBI). **Methods**:Patients with mechanical ventilation for more than 48 hours in ICU from September 2017 to November 2019 were selected. Based on the extubation procedure after the SBT,their D-RSBI was measured using ultrasound and those whose D-RSBI ≥ 1.3 times/(min·mm) were evaluated as high-risk patients with extubation failure,who were randomized into two groups:HFNC group and conventional oxygen therapy group (COT group);The re-intubation rate at 48 h after extubation and,respiratory rate (RR),heart rate (HR),arterial oxygen saturation (SaO_2),arterial carbon dioxide partial pressure ($PaCO_2$),oxygenation index (PaO_2/FiO_2)after extubation at 6 h,24 h,48 h were compared between the two groups. **Results**:A total of 41 patients who met the inclusion criteria were finally included in this study,of which 21 were in the HFNC group and 20 were in the COT group;RR,HR,SaO_2,PaO_2/FiO_2 in the HFNC group were superior to the COT group at 6,24 h after extubation,the difference was statistically significant ($P<0.05$);and there was no significant difference between the

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two groups of $PaCO_2$ ($P > 0.05$); SaO_2, PaO_2/FiO_2 in the HFNC group was significantly higher than that in the COT group 48 h after extubation, and the difference was statistically significant ($P < 0.05$); and there was no significant difference between the two groups of RR, HR, and $PaCO_2$ ($P > 0.05$). The re-intubation rate at 48 h after extubation in the HNFC group was 4.76%, the re-intubation rate in the COT group was 30.00%, and the difference was statistically significant ($P < 0.01$). **Conclusion**: For patients with high-risk of extubation failure based on D-RSBI assessment, the use of HFNC after extubation can significantly improve the patient's respiratory function and oxygenation, and significantly reduce the re-intubation rate, which is an ideal sequential treatment strategy.

[**Key words**] high-flow nasal cannula; conventional oxygen therapy; the diaphragmatic-rapid shallow breathing index; extubation

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气管插管机械通气是抢救危重症患者常用且必要的手段。膈肌是参与呼吸过程中主要的呼吸泵肌肉，自主呼吸时在产生潮气量中起重要作用[1]，机械通气的患者可由于多种因素引起膈肌功能障碍，是撤机失败的重要原因。因此，通过评估膈肌功能筛查撤机失败、困难撤机的高危患者，可以早期发现并采取预防措施，指导成功撤机。Spadaro等[2]研究证实膈肌浅快呼吸指数即呼吸频率与膈肌位移的比值，其值≥1.3次/(min·mm)时预测脱机失败的灵敏度为94.1%，特异度为64.7%，具有较高诊断准确性，可以有效指导撤机。序贯治疗是拔除气管插管，提高脱机成功率至关重要的治疗策略[3]。经鼻高流量氧疗(high-flow nasal cannula，HNFC)是对传统氧疗的革新，其在高流速(40~60 L/min)气流状态下能提供稳定吸入氧浓度的加温加湿气体，能有效促进气道分泌物排出，并能产生呼吸末正压(PEEP)效应，维持呼气末肺容积、改善肺不张，降低呼吸做功[4-5]。本研究通过超声测量膈肌浅快呼吸指数(diaphragmatic-rapid shallow breathing index，D-RSBI)筛选出拔管后呼吸衰竭可能再次插管的高危患者，通过使用HFNC与常规氧疗(conventional oxygen therapy，COT)比较，验证HFNC是否是一种脱机拔管后较理想的序贯治疗策略，能否改善这类高危患者呼吸、氧合状况，降低再插管率，现分析总结如下。

1 对象和方法

1.1 对象

选取2017年9月—2019年11月在南京医科大学附属脑科医院(胸科院区)ICU行机械通气患者，入组标准：①患者年龄>18岁；②气管插管机械通气时间≥48 h，并符合脱机拔管标准；③拔管前行超声测量D-RSBI。排除标准：①观察期间行气管切开患者；②颈8椎体平面以上损伤并伴有截瘫症状；③肥胖及其他因素无法行超声检查的患者。脱机拔管标准参照《机械通气临床应用指南(2006)》[6]：①导致机械通气的病因好转或去除；②氧合指数>150~200 mmHg，PEEP≤5~8 cmH_2O，吸入氧浓度<0.4~0.5，pH≥7.25；③血流动力学稳定，血压不需要血管活性药物维持或仅需要小剂量如多巴胺/多巴酚丁胺维持，24 h内未使用镇静剂；④有自主呼吸能力。本研究经医院伦理委员会批准，所有入组患者均签署知情同意书，

1.2 方法

1.2.1 研究分组及干预处理

所有入组患者行脱机试验开始后30 min，采用超声行右侧膈肌扫描，测量其位移(DD)，同时记录呼吸频率(RR)，以RR/DD测算D-RSBI，其界值取1.3次/(min·mm)，≥1.3次/(min·mm)者评估为脱机拔管高危患者。最终筛选出41例脱机拔管高危患者，随机分为HNFC组(21例)和COT组(20例)。HNFC组拔管后序贯使用HFNC治疗，参数设置为流量40~60 L/min，吸入氧浓度40%~60%，温度37 ℃。COT组拔管后序贯使用鼻导管或面罩吸氧，参数设置为氧流量2~5 L/min。

1.2.2 观察指标

记录两组患者的一般资料，包括性别、年龄、体重、原发疾病、序贯器官衰竭评分(SOFA评分)、气管插管机械通气时间；记录拔管后6、24及48 h两组患者的RR、心率(HR)及动脉血气分析中动脉血氧饱和度(SaO_2)、动脉血二氧化碳分压($PaCO_2$)、氧合指数(PaO_2/FiO_2)；若患者在拔管后48 h内出现严重呼吸衰竭，符合气管插管指征，则行重新插管机械通气治疗。

1.3 统计学方法

用SPSS20.0软件进行数据统计分析，计量资料采用均数±标准差($\bar{x} \pm s$)进行统计描述，两组间比较采用成组t检验；计数资料采用例数和构成比(率)

进行统计描述,组间比较采用卡方检验或Fisher确切概率法。$P < 0.05$则差异具有统计学意义。

2 结 果

2.1 两组患者一般资料比较

两组患者在性别、年龄、体重、原发疾病、SOFA评分、气管插管机械通气时间等一般资料比较上差异无统计学意义($P > 0.05$,表1)。两组患者各基线资料均衡,具有可比性。

2.2 两组患者生命体征和动脉血气分析指标比较

两组患者拔除气管插管后6、24 h,HFNC组RR、HR、SaO_2、PaO_2/FiO_2均优于COT组($P < 0.05$),$PaCO_2$两组差异无统计学意义($P > 0.05$);拔管后48 h HFNC组SaO_2、PaO_2/FiO_2明显高于COT组($P < 0.05$),RR、HR、$PaCO_2$两组差异无统计学意义($P > 0.05$,表2)。

2.3 两组患者48 h再插管率的比较

拔管后48 h内,HNFC组中有1例患者再次气管

表1 两组患者一般资料比较

Table 1 Comparison of general information between two groups

临床资料	HFNC组(n=21)	COT组(n=20)	t/χ^2值	P值
年龄(岁)	70.67 ± 11.82	72.75 ± 13.98	−0.516	0.609
性别[n(%)]			<0.001	1.000
男	17(80.95)	16(80.00)		
女	4(19.05)	4(20.00)		
体重(kg)	64.86 ± 9.48	63.05 ± 10.59	0.576	0.568
SOFA评分(分)	8.14 ± 1.68	8.20 ± 2.04	−0.098	0.922
拔管前机械通气时间(d)	6.38 ± 3.31	6.20 ± 3.16	0.179	0.859
原发疾病[n(%)]			—	1.000
重症肺炎	14(66.67)	13(65.00)		
慢性阻塞性肺病急性加重期	4(19.05)	5(25.00)		
心功能衰竭	2(9.52)	1(5.00)		
胸外科术后	1(4.76)	1(5.00)		

表2 两组患者生命体征和动脉血气分析指标比较

Table 2 Comparison of vital signs and arterial blood gas analysis indexes between two groups

指标	HFNC组(n=20)	COT组(n=14)	t值	P值
拔管后6 h				
RR(次/min)	18.75 ± 2.67	22.43 ± 2.77	−3.894	<0.001
HR(次/min)	85.10 ± 9.91	99.71 ± 13.76	−3.606	0.001
SaO_2	0.97 ± 0.02	0.94 ± 0.03	4.910	<0.001
$PaCO_2$(mmHg)	43.25 ± 6.49	42.57 ± 8.39	0.266	0.792
PaO_2/FiO_2	246.50 ± 28.54	211.00 ± 25.68	3.716	0.001
拔管后24 h				
RR(次/min)	17.65 ± 2.23	21.64 ± 2.73	−4.681	<0.001
HR(次/min)	82.45 ± 9.25	94.86 ± 12.32	−3.357	0.002
SaO_2	0.98 ± 0.01	0.94 ± 0.03	5.311	<0.001
$PaCO_2$(mmHg)	41.50 ± 5.47	40.79 ± 8.26	0.304	0.763
PaO_2/FiO_2	264.60 ± 23.26	234.21 ± 38.87	2.852	0.008
拔管后48 h				
RR(次/min)	18.65 ± 2.30	18.86 ± 1.92	−0.276	0.784
HR(次/min)	87.35 ± 6.58	91.14 ± 9.50	−1.378	0.178
SaO_2	0.97 ± 0.01	0.93 ± 0.02	7.824	<0.001
$PaCO_2$(mmHg)	41.30 ± 4.59	40.50 ± 6.43	0.424	0.674
PaO_2/FiO_2	268.45 ± 23.25	238.50 ± 34.76	3.017	0.005

因两组患者中都有拔管后48 h内再插管情况发生,其生命体征和血气分析指标不纳入统计,故实际样本量HFNC组n=20,COT组n=14。

插管(再插管率为4.76%),COT组有6例患者再次气管插管(再插管率为30.00%),HFNC组再插管率明显低于COT组,差异有统计学意义(χ^2=4.609,P<0.01)。

3 讨 论

在ICU中,机械通气是重要的生命支持手段,随着机械通气时间的延长,呼吸机相关性肺炎、呼吸机相关肺损伤、呼吸机依赖等机械通气相关并发症的发生率明显升高;临床研究证实[7-8],ICU拔管患者中20%~30%在拔管后48 h内会出现呼吸衰竭。如何尽早脱机拔管,并且在拔管后寻求一个适当的序贯氧疗方式,防止呼吸衰竭,减少再插管率,一直是ICU医生关注的问题。大量研究证实膈肌在机械通气的成功撤离中起决定作用[9-11],在机械通气患者中,呼吸机相关性膈肌功能障碍发生率很高,是困难脱机及拔管失败的重要原因。超声技术具有安全、无创、可重复性等特点,目前在ICU作为膈肌功能评估的主要手段。已经有多项研究证明在脱机患者中超声测量的膈肌移动度具有重要评估价值[2,12],本研究采用基于超声测量DD计算出的D-RSBI评估脱机失败具有较高的敏感度和特异度,可有效筛选出脱机拔管失败高风险患者。

拔管后出现呼吸衰竭的高危患者,序贯氧疗是常规手段,一般选择传统氧疗(鼻导管或面罩吸氧)以及无创通气(non-invasive ventilation,NIV)。传统氧疗不能提供加温的气体,且湿化效果差,氧浓度不稳定。研究表明,早期使用NIV可以有效预防拔管后呼吸衰竭,减少再插管率[13],但NIV也存在耐受性差、痰液黏稠、排痰困难、误吸等不良反应,增加了使用风险和不良预后的概率,甚至导致再次气管插管机械通气[14]。大量研究证实HFNC具有以下效应及优势[5,15-17]:是一种新型的无创呼吸支持治疗模式,具有良好的舒适度和耐受性;能够主动加温加湿,精确控制FiO_2,冲刷解剖死腔,降低呼吸频率和改善呼吸做功;产生气道正压,维持呼吸末肺容积并改善肺不张。因此,HFNC近年来在ICU中应用愈加广泛,大规模随机对照研究及荟萃分析均表明对于呼吸衰竭及拔管后患者,HFNC治疗效果优于传统氧疗且不劣于NIV[18-19]。国内卢骁等[20]研究表明,通过肺部超声评分筛选出机械通气拔管后呼吸衰竭高危患者,应用HFNC较传统氧疗能明显改善患者呼吸、氧合,降低再插管率。本研究通过膈肌超声测得D-RSBI,筛选出拔管后呼吸衰竭的高危患者,较肺部超声评分具有更高的灵敏度和特异度,这些患者拔管后序贯HFNC治疗的生命体征、血气分析、氧合指标均明显优于序贯COT治疗的患者,且拔管后48 h再插管率明显低于COT治疗组,表明HFNC对于拔管后呼吸衰竭的高危患者具有改善呼吸衰竭、降低再插管风险的确切疗效,这也佐证了上述研究结果。

总之,本研究通过膈肌超声筛选出高风险脱机拔管患者,证实了在此类患者拔管后序贯使用HFNC较COT可以明显改善患者的呼吸、氧合状况及降低再插管率,是一种比较理想的序贯治疗策略。不足:超声操作医师均为本科室医师,虽然经过超声技能培训,但仍存在不同操作诊断人员导致的评估偏差可能,且高危患者的超声评估仅使用单一指标;本临床研究样本量较少,统计分析可能会存在一定偏倚,尚需要大样本的多中心研究进一步验证。

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