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机械通气新生儿撤机失败的危险因素分析及预防对策探讨*

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摘要 目的:分析机械通气新生儿撤机失败的危险因素,并探讨预防对策。**方法:**回顾性选取2018年4月~2021年3月在我院接受机械通气治疗的256例新生儿的临床资料。根据是否发生撤机失败将患儿分为撤机成功组与撤机失败组。撤机失败的影响因素采用单因素及多因素 Logistic 回归分析,并探讨预防对策。**结果:**256例接受机械通气的新生儿中,有29例发生撤机失败,撤机失败率为11.33%。单因素分析结果显示:撤机成功组与撤机失败组在胎龄、出生体重、Apgar评分、产伤情况、呼吸机相关性肺炎、多脏器功能损害、肺部感染、败血症、营养支持、撤机时血氧分压(PO_2)、撤机时心率、撤机时二氧化碳分压(PCO_2)方面对比差异有统计学意义($P<0.05$)。多因素 Logistic 回归分析结果显示:撤机时 PO_2 偏低、撤机时心率较高、撤机时 PCO_2 较高、多脏器功能损害、无营养支持、伴有肺部感染、发生呼吸机相关性肺炎、胎龄 <37 周是导致机械通气新生儿撤机失败的危险因素($P<0.05$)。**结论:**导致机械通气新生儿撤机失败的危险因素较多,临床应针对危险因素进行干预,并在撤机前进行充分评估以减少撤机失败率。

关键词:机械通气;新生儿;撤机失败;危险因素;预防对策

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Risk Factors Analysis and Explore the Preventive Countermeasures of Weaning Failure in Neonates with Mechanical Ventilation*

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ABSTRACT Objective: To analyze the risk factors of weaning failure of neonates with mechanical ventilation, and to explore the preventive countermeasures. **Methods:** The clinical data of 256 neonates who were treated with mechanical ventilation in our hospital from April 2018 to March 2021 were retrospectively selected. According to whether weaning failure occurred, the neonates were divided into weaning success group and weaning failure group. Logistic regression model was used to analyze the high risk factors of the weaning failure, and the preventive measures were explored. **Results:** Among 256 neonates who received mechanical ventilation, 29 cases failed to wean, and the weaning failure rate was 11.33%. Univariate analysis showed that there were statistically significant differences between the weaning failure group and the weaning failure group in the fetal age, birth weight, Apgar score, birth injury, ventilator-associated pneumonia, multiple organ dysfunction, pulmonary infection, sepsis, nutritional support, partial pressure of blood oxygen (PO_2) at weaning, heart rate at weaning and carbon dioxide partial pressure (PCO_2) at weaning ($P<0.05$). Multivariate Logistic regression analysis showed that lower PO_2 at weaning, higher heart rate at weaning, higher PCO_2 at weaning, multiple organ dysfunction, no nutritional support, with pulmonary infection, with ventilator-associated pneumonia and gestational age <37 weeks were the risk factors for weaning failure in neonates with mechanical ventilation ($P<0.05$). **Conclusion:** There are many risk factors leading to weaning failure in neonates with mechanical ventilation. Clinical intervention should be carried out according to high risk factors, and full evaluation should be carried out before weaning to reduce the weaning failure rate.

Key words: Mechanical ventilation; Neonates; Weaning failure; Risk factors; Preventive countermeasures

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前言

机械通气是危重症新生儿的常用抢救措施,其可为新生儿提供足够的潮气量,降低病死率,在新生儿重症监护室得到了广泛应用^[1]。但机械通气只是辅助危重症新生儿度过难关的一种医疗手段,并不能长期使用,若长期依赖会导致呼吸肌废用性萎缩^[2]。因此,多数新生儿会在呼吸衰竭症状缓解后撤离呼吸机。但也有一部分患儿会出现撤机失败的情况,撤机失败是指

撤离呼吸机后48 h内,患儿的自主呼吸仍无法满足其自身需求,仍有呼吸衰竭的迹象,需要再次接受机械通气的一种情况^[3,4]。通常情况下,撤机指征的评估主要仍依赖临床医生个人经验,缺乏客观的评估方法,导致撤机失败率居高不下^[5]。鉴于上述背景,本研究通过了解接受机械通气治疗的新生儿撤机失败的危险因素,并制定出预防对策,以期降低其临床撤机失败率。

1 资料与方法

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1.1 研究对象

回顾性选取 2018 年 4 月~2021 年 3 月在我院接受机械通气治疗的 256 例新生儿的临床资料。所有临床资料均来自我院新生儿重症监护室临床数据库。纳入标准:(1)临床资料完整;(2)因新生儿重症肺炎、肺出血、新生儿肺透明膜病等引起呼吸衰竭,须行机械通气治疗。排除标准:(1)撤机前确诊心律失常;(2)发生高频通气、意外脱管;(3)撤机前死亡的新生儿;(4)先天性发育异常;(5)因监护人或其他原因导致的非计划撤机;(6)因外科手术需要插管。

1.2 方法

1.2.1 撤机失败判定 脱机前由医生评估患儿,然后进行程序化脱机,脱机后 48 h 内需要再次应用呼吸机则定义为撤机失败。根据是否发生撤机失败将患儿分为撤机失败组与撤机成功组。

1.2.2 临床资料收集 查阅患儿的病历资料,以自制调查表的形式收集患儿的相关临床资料,包括:产伤情况、胎龄、是否伴有肺部感染、机械通气时间、是否有多脏器功能损害、出生体重、败血症、Apgar 评分^①、性别、是否发生呼吸机相关性肺炎、是否有营养支持以及撤机时心率、血氧分压(PO_2)、二氧化碳分压(PCO_2)。Apgar 评分总分为 10 分,分数越高,呼吸状况越好。

1.3 统计学方法

采用 SPSS 24.0 软件分析数据。经检验符合正态分布的计量资料采用($\bar{x} \pm s$)表示,行 t 检验。计数资料采用%表示,行 χ^2 检验。撤机失败的影响因素采用单因素及多因素 Logistic 回归分析。检验水准为 $\alpha=0.05$ 。

2 结果

2.1 撤机失败率

256 例接受机械通气的新生儿中,有 29 例发生撤机失败,撤机失败率为 11.33%。分组结果:撤机失败组 29 例、撤机成功组 227 例。

2.2 撤机失败的单因素分析

单因素分析结果显示:撤机成功组与撤机失败组在性别、机械通气时间方面对比差异无统计学意义($P>0.05$)。撤机成功组与撤机失败组在胎龄、出生体重、Apgar 评分、产伤情况、呼吸机相关性肺炎、多脏器功能损害、肺部感染、败血症、营养支持、撤机时 PO_2 、撤机时心率、撤机时 PCO_2 方面对比有差异($P<0.05$),见表 1。

表 1 撤机失败的单因素分析
Table 1 Univariate analysis of weaning failure

Factors		Waning success group (n=227)	Weaning failure group (n=29)	χ^2/t	P
Fetal age(weeks)	<37	132(58.15%)	24(82.76%)	6.542	0.011
	≥ 37	95(41.85%)	5(17.24%)		
Gender	Male	103(45.37%)	14(48.28%)	0.087	0.768
	Female	124(54.63%)	15(51.72%)		
Mechanical ventilation time(d)	>5	143(63.00%)	19(65.52%)	0.669	0.413
	≤ 5	84(37.00%)	10(34.48%)		
Birth weight(kg)	>3	71(31.28%)	3(10.34%)	5.483	0.019
	≤ 3	156(68.72%)	26(89.66%)		
Apgar score(scores)	≥ 5	167(73.57%)	16(55.17%)	4.269	0.039
	<5	60(26.43%)	13(44.83%)		
Birth injury	Yes	3(1.32%)	2(6.90%)	4.174	0.041
	No	224(98.68%)	27(93.10%)		
Ventilator-associated pneumonia	Yes	28(12.33%)	11(37.93%)	13.046	0.000
	No	199(87.66%)	18(62.07%)		
Multiple organ dysfunction	Yes	147(64.76%)	26(89.66%)	7.275	0.007
	No	80(35.24%)	3(10.34%)		
Pulmonary infection	Yes	158(69.60%)	27(93.10%)	7.085	0.008
	No	69(30.40%)	2(6.90%)		
Sepsis	Yes	35(15.42%)	9(31.03%)	4.406	0.036
	No	192(84.58%)	20(68.97%)		
Nutritional support	Yes	171(75.33%)	15(51.72%)	7.213	0.007
	No	56(24.67%)	14(48.28%)		
Heart rate at weaning(beats/min)		143.87 $\pm$ 13.22	156.71 $\pm$ 14.26	-4.881	0.000
PO_2 at weaning(mmHg)		91.26 $\pm$ 6.20	83.60 $\pm$ 5.17	6.373	0.000
PCO_2 at weaning(mmHg)		45.68 $\pm$ 5.71	56.02 $\pm$ 4.57	-9.370	0.000

2.3 撤机失败的多因素 Logistic 回归分析

以机械通气新生儿撤机是否失败作为因变量(赋值:0=否,1=是),将上述单因素分析(表1)中具有统计学差异的因素作为自变量,纳入多因素 Logistic 回归分析并赋值(见表2),筛选

变量(入 $\alpha=0.05$, 出 $\alpha=0.10$),最终分析结果得出:撤机时 PO_2 偏低、撤机时心率较高、撤机时 PCO_2 较高、多脏器功能损害、无营养支持、伴有肺部感染、发生呼吸机相关性肺炎、胎龄 <37 周是导致机械通气新生儿撤机失败的危险因素($P<0.05$),见表3。

表2 自变量赋值

Table 2 Assignment of independent variables

Independent variables	Assignment
Fetal age	0= ≥ 37 weeks, 1= <37 weeks
Birth weight	0= >3 kg, 1= ≤ 3 kg
Apgar score	0= ≥ 5 scores, 1= <5 scores
Birth injury	0=no, 1=yes
Ventilator-associated pneumonia	0=no, 1=yes
Multiple organ dysfunction	0=no, 1=yes
Pulmonary infection	0=no, 1=yes
Sepsis	0=no, 1=yes
Nutritional support	0=yes, 1=no
PO_2 at weaning	0=normal, 1=lower
Heart rate at weaning	0=normal, 1=higher
PCO_2 at weaning	0=normal, 1=higher

表3 撤机失败的多因素 Logistic 回归分析

Table 3 Multivariate Logistic regression analysis of weaning failure

Variables	β	SE	Wald χ^2	OR(95%CI)	P
Lower PO_2 at weaning	0.512	0.138	13.128	1.736(1.248~2.364)	0.000
Higher heart rate at weaning	0.635	0.296	10.364	2.825(1.692~4.831)	0.000
Higher PCO_2 at weaning	0.873	0.274	8.463	1.725(1.559~2.943)	0.001
Multiple organ dysfunction	0.739	0.234	12.691	2.248(1.572~3.167)	0.000
No nutritional support	0.664	0.196	7.315	1.639(1.219~2.483)	0.002
With ventilator-associated pneumonia	0.916	0.225	19.672	2.831(1.825~3.419)	0.000
With pulmonary infection	0.843	0.182	6.351	1.749(1.346~2.519)	0.003
Gestational age <37 weeks	0.791	0.278	8.491	2.206(1.279~3.805)	0.001

3 讨论

机械通气对于危重症新生儿而言,是辅助其度过呼吸难关的一种医疗手段,能为治疗其病症创造有利条件,但机械通气并非长久之计,过度使用会导致多种并发症的发生^[7-9]。因此,从使用机械通气时就应做好撤机计划,尽可能的帮助危重症新生儿尽快恢复自主呼吸功能,以顺利完成撤机工作。本次观察结果显示,选取的256例患儿中有29例撤机失败,撤机失败率为11.33%,撤机失败率略低于既往的报道^[10],这种差异可能与临床医师存在实践差异行为有关。

影响撤机失败的因素众多,本次研究发现,撤机时 PO_2 偏低、撤机时心率较高、撤机时 PCO_2 较高、多脏器功能损害、胎龄 <37 周、发生呼吸机相关性肺炎、无营养支持、伴有肺部感染均是撤机失败的危险因素。新生儿胎龄越小,其呼吸道发育越不完善,黏膜易水肿,撤机后发生喉喘鸣^[11];同时肺的顺应性

小于胸廓,容易发生呼吸肌疲劳^[12];此外早产儿机体免疫功能发育差,抵抗力低下^[13];以上均是早产儿容易撤机失败的重要原因。伴有肺部感染以及并发呼吸机相关性肺炎的患儿肺顺应性差,易造成肺的过度膨胀,加重肺损伤,从而增加了撤机失败风险^[14,15]。多脏器损害是撤机失败的危险因素,这与江秋霞等^[16]学者的研究一致。多脏器损害会影响人体呼吸、免疫功能等,破坏内环境稳态,提高撤机失败发生风险^[17]。无营养支持的新生儿极易发生营养不良,而营养不良时机体会将蛋白质分解以提供能量,减弱呼吸做功能力,致使新生儿对呼吸机产生依赖,无法及时撤机^[18-20]。临床医生撤机前均会考察患儿心率及血气分析指标,本次研究发现:撤机时 PO_2 偏低、撤机时心率较高、撤机时 PCO_2 较高是撤机失败的危险因素,这与李军等人^[21]的报道一致。提示如果新生儿达到撤机标准,但撤机时心率、 PCO_2 较高, PO_2 较低,可以考虑适当推迟撤机时间。

针对本研究结果分析,我们认为预防机械通气新生儿撤机

失败的措施可以有以下几点:(1)撤机前预见性评估新生儿病情发展状况,对患儿意识及多脏器功能损害情况、血气分析结果等密切监测,撤机时先试停呼吸机1h,待新生儿病情平稳后再撤机^[22,23]。(2)最大程度减少吸痰次数,吸痰时确保操作无菌且规范;保持口腔清洁、手卫生,每日用紫外线循环消毒;定时更换体位,防止误吸^[24,25]。(3)机械通气时,给予患儿足够的营养支持,确保热量充足,并减少摄入碳水化合物,适当补充矿物质、维生素、免疫球蛋白等^[26,27]。(4)针对有肺部感染的患儿应根据药敏检查结果合理使用抗生素,避免或减少呼吸机相关性肺炎发生^[28,29];(5)气管插管对于患儿毕竟是有创性操作,医务人员应提高气道管理的技能,正确掌握激素应用的时机及指征,从而降低撤机失败率^[30]。

综上所述,导致机械通气新生儿撤机失败的危险因素较多,对于撤机失败要仔细分析原因,有针对性地消除不利因素,应制定个体化撤机方案,以达到成功撤机之目的。本次研究为一项回顾性单中心研究,研究对象数量相对有限,后续将进一步扩大样本量、联合多中心进行深入分析研究。

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