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不同量表用于机械通气新生儿急性疼痛评估的价值分析*

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摘要 目的:分析和比较不同量表用于机械通气新生儿急性疼痛评估的价值。**方法:**使用总结性、回顾性研究方法,研究时间为2017年3月份到2018年7月份,选择在医院NICU接受机械通气诊治的新生儿56例作为研究对象,所有新生儿都给予高频震荡通气治疗,急性疼痛采用新生儿疼痛/激惹与镇静量表、新生儿急性疼痛评估量表进行评估与分析,记录评估效果。**结果:**新生儿疼痛/激惹与镇静量表的总体Cronbach α 系数为0.698分,最高评分为基础行为状态,最低评分为心率增快。新生儿急性疼痛评估量表的内部一致性总体Cronbach α 系数为0.822,最高评分为胎龄,最低评分为SaO₂。新生儿疼痛/激惹与镇静量表的护理人员一致性组内相关系数(ICC)为0.992,新生儿急性疼痛评估量表的护理人员一致性组内相关系数ICC为0.987。以新生儿疼痛/激惹与镇静量表作为效标,新生儿急性疼痛评估量表的效标关联效度Spearman相关系数为r=0.855, P=0.007。12名护理人员对新生儿急性疼痛评估量表的选择率为66.7%,对新生儿疼痛/激惹与镇静量表的选择率为33.3%。**结论:**新生儿疼痛/激惹与镇静量表和新生儿急性疼痛评估量表在机械通气新生儿急性疼痛评估中都有很好的信度与一致性,其中新生儿急性疼痛评估量表的可行性和临床实用性更好。

关键词:新生儿疼痛/激惹与镇静量表;新生儿急性疼痛评估量表;机械通气

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Analysis of the Values of Different Scales for Acute Pain Assessment in Mechanically Ventilated Neonates*

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ABSTRACT Objective: To analyze and compare the value of different scales for the assessment of acute pain in mechanically ventilated neonates. **Methods:** A summary and retrospective study method were used. The study time were from March 2017 to July 2018. 56 neonates who received mechanical ventilation in hospital were selected as the research subjects. All newborns were given high frequency oscillating ventilation, the acute pain were assessed and analyzed by using the Neonatal Pain/Irritation and Sedation Scale, Neonatal Acute Pain Assessment Scale, and the assessment were recorded. **Results:** The overall Cronbach alpha coefficient of the Neonatal Pain/Irritation and Sedation Scale were 0.698, with the highest score being the underlying behavioral state and the lowest score being the increased heart rate. The internal consistency of the Neonatal Acute Pain Assessment Scale of Cronbach alpha coefficient were 0.822, with the highest score being gestational age and the lowest score being SaO₂. The correlation coefficient (ICC) for the caregiver of the neonatal pain/irritation and sedation scale were 0.992, and the correlation coefficient ICC for the caregiver consistency group on the neonatal acute pain assessment scale were 0.987. Using the Neonatal Pain/Irritation and Sedation Scale as a criterion, the Spearman correlation coefficient of the Newborn Acute Pain Assessment Scale were r=0.855, P=0.007. 12 Nursing Staff Assessment of Acute Pain in Newborns The selection rate of the scale were 66.7%, and the selection rate for the neonatal pain/irritation and sedation scale were 33.3%. **Conclusion:** The Neonatal Pain/Irritation and Sedation Scale Neonatal Acute Pain Assessment Scale has good reliability and consistency in the assessment of acute pain in mechanically ventilated neonates. The feasibility of the Neonatal Acute Pain Assessment Scale And clinical utility is better.

Key words: Neonatal pain/irritation and sedation scale; Neonatal acute pain assessment scale; Mechanical ventilation

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前言

早产或者有严重代谢病的新生儿需要接受新生儿重症监护室(NICU)生命支持,以降低新生儿的死亡率,减少并发症。但

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是患儿在治疗的过程要接受诊断和治疗,会遭受频繁的疼痛刺激,如常见的机械通气、高频振荡通气(High frequency oscillatory ventilation, HFOV)等,都会给其带来一定的疼痛,造成近期或远期的不良影响,影响其健康与发育^[1-4]。由于新生儿缺乏主诉疼痛能力,镇痛药物的应用也有一定的限制,临床上对这种疼痛没有严格评价与治疗,使得机械通气新生儿急性疼痛评估面临许多问题。为了加快新生儿康复、增加舒适及满意度、缩短住院时间,需要准确评价疼痛^[5-6]。

目前,疼痛评估量表是临床上识别新生儿疼痛迹象的主要依据,其涉及的指标主要为心率、呼吸、血氧饱和度、面部表情、肢体活动、睡眠/觉醒状态和哭闹等^[7-8]。机械通气新生儿遭受疼痛刺激时面部表情和行为动作改变有一定的特殊性,可能表现出无疼痛行为反应状态,若仅依据常规指标进行单一评估会出现一定的错误^[9]。新生儿急性疼痛评估量表(Neonatal Infant Acute Pain Assessment Scale, NIAPAS)和新生儿疼痛/激惹与镇静量表(Neonatal Pain, Agitation, and Sedation Scale, N-PASS)已被验证可用于评估新生儿的疼痛^[10,11],但是在机械通气新生儿急性疼痛评估中的应用率还比较低,临床实用性还有待进一步验证。本研究分析和比较了上述两种量表用于机械通气新生儿急性疼痛评估的价值,旨在为机械通气新生儿急性操作性疼痛提供更加有效的评估工具。现总结报道如下。

1 资料与方法

1.1 研究对象

本研究采用总结性、回顾性研究方法,经医院伦理委员会批准,研究时间为2017年3月份到2018年7月份。选择在我院NICU接受机械通气诊治的新生儿56例作为研究对象,纳入标准:家长签署知情同意书;首次入院新生儿;临床资料完整;入住NICU行机械通气支持的新生儿;出生胎龄>32周;具有机械通气指征。排除标准:诊断为膈疝、瘫痪、腭裂、神经严重受损的新生儿;出生后日龄小于1d且大于30d者;多次入院新生儿;严重先天发育畸形;合并先天性心肝肾异常者。

56例新生儿中,男30例,女26例;平均出生胎龄为 36.22 ± 1.49 周,年龄32-34周15例;平均日龄为 8.29 ± 2.23 d;平均5 min Apgar评分为 8.53 ± 1.48 分,平均1 min Apgar评分为 7.83 ± 0.45 分;平均出现体重为 2566.02 ± 623.19 g;疾病类型:呼吸窘迫综合征14例,新生儿肺炎16例,肺透明膜病14例,其他12例。

1.2 机械通气方法

所有新生儿都给予高频震荡机(Drager的V500型)进行通气治疗。通气参数:振荡频率:10-15Hz;平均气道压:15-20 cmH₂O;振荡压力幅度:25-40 cmH₂O;吸入氧分数(FiO₂):60%-100%。

1.3 疼痛评估方法

新生儿疼痛/激惹与镇静量表(Neonatal Pain, Agitation, and Sedation Scale, N-PASS):主要是评价早产儿和足月儿的急性疼痛,通过情境、生理、行为3方面,观察新生儿的面部动作、心率、氧饱和度等7个指标。每个条目根据新生儿对疼痛刺激的不同反应程度分为0-3分,除胎龄和行为状态之外的五个条目小计总分之和>0分,量表总分为21分,总分分值与新生儿疼痛程度成正比。

新生儿急性疼痛评估量表(Neonatal Infant Acute Pain Assessment Scale, NIAPAS):是一种专业的多维疼痛量表,可用早产儿和足月儿的急性疼痛评估,包括心率、呼吸、血氧饱和度、胎龄等9个指标,总分为0-18分,量表总分的分值越高,分数越高,疼痛越严重。

1.4 量表的实施效果调查

由研究者通过电子病历获取NICU新生儿的人口统计学资料,包括入院号、性别、年龄等基本资料,也有疾病类型、5 min Apgar评分、1 min Apgar评分等。由NICU护理人员对量表使用性、可行性等进行评估。每个条目计0-5分,分数越高,越同意此次量表分析。上述所有疼痛都在评估后由护理人员填写量表可行性和临床实用性问卷,并当场收回,调查的有效率为100.0%。

1.5 统计学分析

选择SPSS19.00软件,计量数据采用,数据采用百分比、率等描述,对比为t检验与开放分析,内部一致性信度以采用Cronbach α 系数评价,同时以组内相关系数(Intra-class Correlation Coefficient, ICC)评价不同护理人员的评分一致性,以 $P < 0.05$ 为差异具有统计学意义。

2 结果

2.1 内部一致性信度分析

新生儿疼痛/激惹与镇静量表的总体Cronbach α 系数为0.698分,最高评分为基础行为状态,最低评分为心率增快,见表1。新生儿急性疼痛评估量表的内部一致性总体Cronbach α 系数为0.822,最高评分为胎龄,最低评分为SaO₂,见表2。

表1 新生儿疼痛/激惹与镇静量表各条目得分及对总分的贡献情况(n=56)

Table 1 Scores of the entries for the Newborn Pain/Irritation and Sedation Scale and their contribution to the total score (n=56)

Item	$\bar{x} \pm s$	Cronbach α factor
Gestational age	1.073 $\pm$ 0.950	0.753
Underlying behavior state	2.861 $\pm$ 0.394	0.744
Nasolabial groove deepening	0.922 $\pm$ 1.219	0.537
Blink the eyes	0.926 $\pm$ 1.216	0.532
Frowning	0.922 $\pm$ 1.217	0.539
Blood oxygen desaturation	0.850 $\pm$ 1.151	0.743
Increased heart rate	0.802 $\pm$ 0.898	0.733

表 2 新生儿急性疼痛评估量表各条目得分及对总分的贡献情况(n=56)

Table 2 Scores of entries for the Newborn Acute Pain Assessment Scale and their contribution to the total score (n=56)

Item	$\bar{x} \pm s$	Cronbach α factor
SaO ₂	0.162± 0.540	0.881
Heart rate	0.892± 0.508	0.851
Reaction to operation	0.545± 0.730	0.772
Breathing	0.304± 0.460	0.798
Muscular tension	0.380± 0.485	0.780
Cry and scream	0.580± 0.998	0.770
Facial expression	0.630± 0.828	0.776
Vigilance	0.471± 0.683	0.779
Gestational age	1.111± 0.925	0.887

2.2 护理人员间一致性信度

本次研究中共有 12 名 NICU 护理人员参与两种量表应用型进行问卷调查。NICU 护理人员全为女性,年龄最小 21 岁,最大 42 岁,平均年龄 30.18± 2.48 岁;学历:大专 8 例,本科 4 例;职称:初级 10 例,中级 2 例;平均 NICU 工作年限为 5.20± 1.29 年。

护理人员对 ICC 评价的一致性组内相关系数为 0.992,对

NIAPAS 评价一致性组内相关系数 ICC 为 0.987。

2.3 效标关联效度

以 ICC 量表作为效标,NIAPAS 量表的效标关联效度 Spearman 相关系数为 $r=0.855$, $P=0.007$ 。新生儿 ICC 的量表评估耗时短条目同意率大于 50%,其他条目同意率均小于 50%;NIAPAS 的 66.7%(8/12)和新 ICC 量表的 33.3%(4/12)。具体评分状况见表 3。

表 3 不同护理人员对不同机械通气新生儿急性疼痛评估量表的应用评分(n=12)

Table 3 Application scores of different caregivers for different mechanical ventilation neonatal acute pain assessment scales (n=12)

Item	Neonatal pain / irritation and sedation scale	Neonatal acute pain assessment scale
Scale helps pain management	3.702± 0.902	3.884± 1.094
Scale helps identify neonatal pain	7.752± 0.850	3.834± 1.111
Clinical feasibility	3.851± 0.833	3.930± 1.492
Scoring guidelines are easy to understand	3.833± 1.093	3.801± 1.114
The scoring method is simple	3.556± 1.144	3.948± 1.089
Scale assessment is easy	3.534± 1.093	3.999± 1.592
Scale assessment is time consuming	3.750± 1.078	3.930± 0.983
The scale is simple to use	3.485± 0.782	3.902± 0.887
Scale can standardize pain assessment	3.482± 1.044	3.889± 1.155

3 讨论

新生儿由于自身的条件对疼痛没有正确的认识,不能用语言准确表达疼痛,又不能用药,疼痛会对新生儿带来不良影响^[12-14]。有研究调查显示 1122 例新生儿在 2 周的 NICU 住院期间共经历了 24000 多次疼痛性操作,平均每人每天经历 12 次。机械通气新生儿的疼痛普遍存在,但其疼痛评估和疼痛缓解严重不足^[15]。如机械通气支持治疗的新生儿,动脉采血、足跟针刺采血等常见的治疗都会使新生儿面临的疼痛刺激风险^[16]。这种持续疼痛会对发育产生严重的影响,诱发出儿童期神经系统发育迟缓、行为功能障碍等表现^[17]。因此,在治疗中,需要及时的评价新生儿急性疼痛程度,根据疼痛评估制定相应护理干预,能改善新生儿的预后^[18]。传统的修订版早产儿疼痛量表应用于评估胎龄 <28 周的超低胎龄早产儿急性疼痛时,具有良好的效度和可行性,但是内部一致性一直不高^[19]。

本研究结果显示新生儿疼痛 / 激惹与镇静量表的总体 Cronbach α 系数为 0.698 分,最高评分为基础行为状态,最低评分为心率增快;新生儿急性疼痛评估量表的内部一致性总体 Cronbach α 系数为 0.822,最高评分为胎龄,最低评分为 SaO₂,提示两种疼痛评估量表可更加直观、有效地反映新生儿机械通气期间疼痛变化过程,规避以上疼痛评分法对新生儿疼痛评估时的弊端^[20]。有研究采用新生儿疼痛 / 激惹与镇静量表和急性疼痛评估量表评估新生儿行机械通气的疼痛状况,结果验证了其有较好的内部一致性信度、与信度、判别效度^[21]。这两种量表均能够反映新生儿疼痛程度,指导医护人员进行护理干预,减少并发症,增加舒适度^[22,23]。

量表的信度衡量指标又称内部一致性系数和护理人员间一致性的组内关系数,是内部一致性信度和护理人员间一致性信度^[24]。本研究显示新生儿疼痛 / 激惹与镇静量表的护理人员一致性组内相关系数(ICC)为 0.992,新生儿急性疼痛评估量表

的护理人员一致性组内相关系数 ICC 为 0.987。以新生儿疼痛 / 激惹与镇静量表作为效标,新生儿急性疼痛评估量表的效标关联度 Spearman 相关系数为 $r=0.855$,说明护理人员之间的差异对两种量表疼痛评分影响较小,评估者之间有较好的一致性,可能与量表均包含面部表情等类似条目有关。

机械通气新生儿入住 NICU 期间可遭受大量的度疼痛刺激,临床上应重视新生儿的疼痛问题,用相应的量表进行评估,帮助护理人员提高护理效率^[29]。本研究结果显示新生儿疼痛 / 激惹与镇静量表中的量表评估耗时短条目同意率大于 50%,其他条目同意率均小于 50%;新生儿急性疼痛评估量表中的评价条目同意率均大于 50%。12 名护理人员对两种量表的首选率依次为新生儿急性疼痛评估量表的 66.7%和新生儿疼痛 / 激惹与镇静量表的 33.3%。两种量表在条目总数量、某些条目的计分方式和条目指标构成等方面都一定的不足,新生儿急性疼痛量表可行性低,但临床实用性强^[26-28]。虽然面部表情可以反映机械通气新生儿的疼痛,但是面部表情变化相关的指标构成的新生儿疼痛 / 激惹与镇静量表需要通过计算这些条目持续的时间长,计分方式更复杂,因而其可行性和实用性均比较低^[29-31]。本研究也有一定的不足,如研究的样本数量比较少,且为单中心研究,护理人员依次使用固定顺序的两种量表对机械通气新生儿进行疼痛评估,可能存在研究偏倚,这将在下一步研究中进行完善。

总之,新生儿疼痛 / 激惹与镇静量表和新生儿急性疼痛评估量表在机械通气新生儿急性疼痛评估中都有很好的信度与一致性,以新生儿急性疼痛评估量表的可行性和实用性更好,可用于机械通气新生儿疼痛评估。

参考文献(References)

- [1] Perroteau A, Nanquette MC, Rousseau A, et al. Efficacy of facilitated tucking combined with non-nutritive sucking on very preterm infants' pain during the heel-stick procedure: A randomized controlled trial [J]. *Int J Nurs Stud*, 2018, 15(86): 29-35
- [2] Moriarty O, Harrington L, Beggs S, et al. Opioid analgesia and the somatosensory memory of neonatal surgical injury in the adult rat[J]. *Br J Anaesth*, 2018, 121(1): 314-324
- [3] Garriga J, Laumet G, Chen SR, et al. Nerve Injury-Induced Chronic Pain Is Associated with Persistent DNA Methylation Reprogramming in Dorsal Root Ganglion[J]. *J Neurosci*, 2018, 38(27): 6090-6101
- [4] Desai A, Aucott S, Frank K, Silbert-Flagg J. Comparing N-PASS and NIPS: Improving Pain Measurement in the Neonate[J]. *Adv Neonatal Care*, 2018, 18(4): 260-266
- [5] Davis SM, Rice M, Rudlong J, et al. Neonatal pain and stress disrupts later-life pavlovian fear conditioning and sensory function in rats: Evidence for a two-hit model[J]. *Dev Psychobiol*, 2018, 60(5): 520-533
- [6] Fernandes HS, Bliacheriene F, Vago TM, et al. Clonidine Effect on Pain After Cesarean Delivery: A Randomized Controlled Trial of Different Routes of Administration [J]. *Anesth Analg*, 2018, 127(1): 165-170
- [7] Holly C, Porter S, Echevarria M, et al. CE: Original Research: Recognizing Delirium in Hospitalized Children: A Systematic Review of the Evidence on Risk Factors and Characteristics [J]. *Am J Nurs*, 2018, 118(4): 24-36
- [8] Bourgoin L, Caeymaex L, Decobert F, et al. Administering atropine and ketamine before less invasive surfactant administration resulted in low pain scores in a prospective study of premature neonates[J]. *Acta Paediatr*, 2018, 107(7): 1184-1190
- [9] Hung KKC, Graham CA, Lo RSL, et al. Oral paracetamol and/or ibuprofen for treating pain after soft tissue injuries: Single centre double-blind, randomised controlled clinical trial[J]. *PLoS One*, 2018, 13(2): e0192043
- [10] Yu B, Ferrari M, Schleifer G, et al. Development of a portable mini-generator to safely produce nitric oxide for the treatment of infants with pulmonary hypertension[J]. *Nitric Oxide*, 2018, 1(75): 70-76
- [11] Fuentes IM, Pierce AN, Di Silvestro ER, et al. Differential Influence of Early Life and Adult Stress on Urogenital Sensitivity and Function in Male Mice[J]. *Front Syst Neurosci*, 2018, 9(11): 97
- [12] Cremillieux C, Makhlof A, Pichot V, et al. Objective assessment of induced acute pain in neonatology with the Newborn Infant Parasympathetic Evaluation index[J]. *Eur J Pain*, 2018, 22(6): 1071-1079
- [13] McDowall J, Adam A, Gerber L, et al. The ultrasonographic "whirlpool sign" in testicular torsion: valuable tool or waste of valuable time? A systematic review and meta-analysis [J]. *Emerg Radiol*, 2018, 25(3): 281-292
- [14] Verstraete J, Ramma L, Jelsma J. Influence of the child's perceived general health on the primary caregiver's health status[J]. *Health Qual Life Outcomes*, 2018, 16(1): 8
- [15] Valeri BO, Gasparido CM, Martinez FE, et al. Effectiveness of Sucrose Used Routinely for Pain Relief and Neonatal Clinical Risk in Preterm Infants: A Nonrandomized Study[J]. *Clin J Pain*, 2018, 34(8): 713-722
- [16] Zeilmaker-Roest GA, van Rosmalen J, van Dijk M, et al. Intravenous morphine versus intravenous paracetamol after cardiac surgery in neonates and infants: a study protocol for a randomized controlled trial [J]. *Trials*, 2018, 19(1): 318
- [17] Desai A, Aucott S, Frank K, et al. Comparing N-PASS and NIPS: Improving Pain Measurement in the Neonate [J]. *Adv Neonatal Care*, 2018, 18(4): 260-266
- [18] Bhat BV, Plakkal N. Non-pharmacologic Measures for Pain Relief in Preterm Neonates[J]. *Indian Pediatr*, 2018, 55(4): 287-288
- [19] Zunino C, Notejane M, Bernadé M, et al. Pain in children and adolescents hospitalized in a center of reference [J]. *Rev Chil Pediatr*, 2018, 89(1): 67-73
- [20] Richter M, Seipolt B. Pain therapy for premature babies and neonates [J]. *Schmerz*, 2018, 32(2): 153-164
- [21] Holly C, Porter S, Echevarria M, et al. CE: Original Research: Recognizing Delirium in Hospitalized Children: A Systematic Review of the Evidence on Risk Factors and Characteristics [J]. *Am J Nurs*, 2018, 118(4): 24-36
- [22] Matsushita Y, Hoshino H, Shimojo N, et al. Verifying the validity and reliability of the Japanese version of the Face, Legs, Activity, Cry, Consolability (FLACC) Behavioral Scale[J]. *PLoS One*, 2018, 13(3): e0194094
- [23] Shukla VV, Bansal S, Nimbalkar A, et al. Pain Control Interventions in Preterm Neonates: A Randomized Controlled Trial[J]. *Indian Pediatr*, 2018, 55(4): 292-296

(下转第 283 页)

- [20] Hegde MN, Moany A. Remineralization of enamel subsurface lesions with casein phosphopeptide-morphous calcium phosphate: a quantitative energy dispersive X-ray analysis using scanning electron microscopy:An in vitro study[J]. *Conserv Dent*, 2012, 15(1): 61-67
- [21] Li Shu hui, Wu Pei-ling. Casein phosphopeptide-stabilized amorphous calcium phosphate solutions and its application in dental fields [J]. *Chinese Journal of Conservative Dentistry*, 2011, 21(10): 601-603
- [22] Peric T, Markovic D, Petrovic B, et al. Effect of three different pastes on remineralization of initial enamel lesion:an in vitro study. *Clin Pediatr[J]. Dent*, 2015, 39(2): 149-160
- [23] Zhou C, Zhang D, Bai Y, et al. Casein phosphopeptide-amorphous calcium phosphate remineralization of primary teeth early enamel lesions[J]. *J Dent*, 2014, 42(1): 21-29
- [24] Mettu S, Srinivas N, Reddy Sampath CH, et al. Effect of casein phosphopeptide-amorphous calcium phosphate (cpp-acp) on caries-like lesions in terms of time and nano-hardness: An in vitro study[J]. *J Indian Soc Pedod Prev Dent*, 2015, (4): 269-273
- [25] Memarpour M, Soltanimehr E, Sattarahmady N. Efficacy of calcium- and fluoride-containing materials for the remineralization of primary teeth with early enamel lesion [J]. *Microsc Res Tech*, 2015,78(9): 801-806
- [26] Rezvani MB, Karimi M, Akhavan Rasoolzade R, et al. Comparing the Effects of Whey Extract and Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) on Enamel Microhardness [J]. *J Dent (Shiraz)*, 2015, 16(1): 49-53
- [27] Rezayi T, Entezari MH. Toward a durable superhydrophobic aluminum surface by etching and ZnO nanoparticle deposition[J]. *J Colloid Interface Sci*, 2016 , 463: 37-45
- [28] Zelic K, Milovanovic P, Rakocevic Z, et al. Nano-structural and compositional basis of devitalized tooth fragility[J]. *Dent Mater*, 2014, 30(5): 476-486
- [29] Vitale MC, Zaffe D, Botticell AR, et al. Diode laser irradiation and fluoride uptake in human teeth. *European archives of paediatric dentistry[J]. official journal of the European Academy of Paediatric Dentistry*, 2011, 12(2): 90-92
- [30] HuJing, ChenZeng-li, LiuJi-yan, et al. Analysis of Different Techniques Applied in the Dental CariesTreatment of Deciduous Teeth[J]. *Progress in Modern Biomedicine*, 2015, 15(4): 668-671

(上接第 265 页)

- [24] Boles J. Non-Pharmacological Strategies for Addressing Infant Pain [J]. *Pediatr Nurs*, 2017, 43(2): 98-100
- [25] Hatfield LA, Hoffman RK, Polomano RC, et al. Epigenetic Modifications Following Noxious Stimuli in Infants [J]. *Biol Res Nurs*, 2018, 20(2): 137-144
- [26] Cremillieux C, Makhlouf A, Pichot V, et al. Objective assessment of induced acute pain in neonatology with the Newborn Infant Parasym pathetic Evaluation index[J]. *Eur J Pain*, 2018, 22(6): 1071-1079
- [27] Gianni ML, Roggero P, Baudry C, et al. No effect of adding dairy lipids or long chain polyunsaturated fatty acids on formula tolerance and growth in full term infants: a randomized controlled trial[J]. *BMC Pediatr*, 2018, 18(1): 10
- [28] Klarer N, Rickenbacher H, Kasser S, et al. Electrophysiological Measurement of Noxious-evoked Brain Activity in Neonates Using a Flat-tip Probe Coupled to Electroencephalography [J]. *J Vis Exp*, 2017, (129): 56531
- [29] Valeri BO, Gasparido CM, Martinez FE, et al. Effectiveness of Sucrose Used Routinely for Pain Relief and Neonatal Clinical Risk in Preterm Infants: A Nonrandomized Study[J]. *Clin J Pain*, 2018, 34(8): 713-722
- [30] Gardner FC, Adkins CS, Hart SE, et al. Preterm Stress Behaviors, Autonomic Indices, and Maternal Perceptions of Infant Colic[J]. *Adv Neonatal Care*, 2018, 18(1): 49-57
- [31] Carpentier E, Moreau F, Soriot-Thomas S, et al. Training program for pain assessment in the newborn[J]. *Arch Pediatr*, 2018, 25(1): 35-38