

局部浸润麻醉在全身麻醉下重度低龄儿童龋治疗中血流动力学及镇痛效果的临床研究

卢晓熾¹ 杨宽² 张百泽¹ 张亚秋³ 王军辉¹ 韩欣欣¹ 陈宇江¹ 王小竞¹

1. 口腔系统重建与再生全国重点实验室, 国家口腔疾病临床医学研究中心, 陕西省口腔生物工程技术研究中心, 第四军医大学口腔医院儿童口腔科, 西安 710032;

2. 青岛大学附属医院口腔正畸科, 青岛大学口腔医学院, 青岛 266003;

3. 口腔系统重建与再生全国重点实验室, 国家口腔疾病临床医学研究中心, 陕西省口腔生物工程技术研究中心, 第四军医大学口腔医院麻醉科, 西安 710032

[摘要] **目的** 探讨全身麻醉下重度低龄儿童龋 (SECC) 治疗联合应用局部麻醉的临床应用疗效。**方法** 选取2023年3—12月于空军军医大学第三附属医院儿童口腔科进行全身麻醉下SECC治疗的108例6岁以下儿童为研究对象, 美国麻醉医师协会 (ASA) 分级为 I 类或 II 类, 通过调取术中病例及术后回访记录将研究对象分为对照组 ($n=54$) 和实验组 ($n=54$)。对照组采用静吸复合经鼻气管插管全身麻醉方式, 实验组在实施全身麻醉的基础上, 采用2%利多卡因对每颗采用所研究4种术式 (间接牙髓治疗术、牙髓切断术、根管治疗术、牙拔除术) 的治疗牙进行局部麻醉。记录并分析2组患儿基本信息、术前麻醉深度、术中不同术式的血流动力学变化和术后疼痛情况及不良反应。**结果** 2组患儿基本信息和术前麻醉深度差异无统计学意义 ($P>0.05$), 除间接牙髓治疗术外, 在其余3种术式 (牙髓切断术、根管治疗术、牙拔除术) 中, 实验组的3项观察指标均显著小于对照组 ($P<0.05$), 实验组根据改良面部疼痛量表 (FPS-R) 评分需采取镇痛措施的比率在术后清醒时和术后2 h显著小于对照组 ($P<0.05$), 术后24 h组间差异无统计学意义 ($P>0.05$)。实验组根据父母疼痛测量量表 (PPPM) 评分需采取镇痛措施的比率在术后清醒时显著小于对照组 ($P<0.05$), 术后2 h和术后24 h组间差异无统计学意义 ($P>0.05$)。2组患儿术后24 h不良反应发生率的组间差异无统计学意义 ($P>0.05$)。**结论** 全身麻醉下SECC治疗联合使用局部麻醉后, 术中血流动力学变化较小, 术后疼痛反应较轻, 值得临床推广。

[关键词] 重度低龄儿童龋; 全身麻醉; 局部麻醉; 疼痛管理; 血流动力学

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Clinical study on hemodynamics and analgesic effect of local infiltration anesthesia in the treatment of severe early childhood caries under general anesthesia

Lu Xiaoxi¹, Yang Kuan², Zhang Baize¹, Zhang Yaqiu³, Wang Junhui¹, Han Xinxin¹, Chen Yujiang¹, Wang Xiaojing¹

1. State Key Laboratory of Oral & Maxillofacial Reconstruction and Regeneration, National Clinical Research Center for Oral Diseases, Shaanxi Oral Bioengineering Technology Research Center, Dept. of Pediatric Dentistry, School of Stomatology, The Fourth Military Medical University, Xi'an 710032, China; 2. Dept. of Orthodontics, Qingdao University Affiliated Hospital, School of Stomatology, Qingdao University, Qingdao 266003, China; 3. State Key Laboratory of Oral & Maxillofacial Reconstruction and Regeneration, National Clinical Research Center for Oral Diseases, Shaanxi

Oral Bioengineering Technology Research Center, Dept. of Anesthesiology, School of Stomatology, The Fourth Military Medical University, Xi'an 710032, China

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[第一作者] 卢晓熾, 医师, 博士, E-mail: 15232115135@163.com

[通信作者] 王小竞, 教授, 博士, E-mail: wxjing@fmmu.edu.cn

Education and Teaching Research at the Third Affiliated Hospital of Air Force Medical University (417172122)

Correspondence: Wang Xiaojing, E-mail: wxjing@fmmu.edu.cn

[Abstract] Objective This study aimed to explore the clinical efficacy of severe early childhood caries (SECC) treatment combined with local anesthesia under general anesthesia. **Methods** A total of 108 children under 6 years old who underwent SECC dental treatment under general anesthesia at the Department of Pediatric Dentistry, Third Affiliated Hospital of Air Force Medical University from March to December 2023 were selected as the study subjects, with American Society of Anesthesiologists (ASA) classification of class I or II. The study subjects were divided into a control group ($n=54$) and an experimental group ($n=54$) by retrieving intraoperative cases and postoperative follow-up records. The control group was given general anesthesia through inhalation combined with nasotracheal intubation, whereas the experimental group was given local anesthesia with 2% lidocaine on each treated tooth on the basis of general anesthesia. The basic information, preoperative anesthesia depth, hemodynamic changes during different surgical procedures, postoperative pain, and adverse reactions in the two groups were recorded and analyzed. **Results** No statistically significant difference was found in the basic information and preoperative anesthesia depth between the two groups ($P>0.05$). Among the three procedures (pulpotomy, root canal treatment, and tooth extraction), the three observed indicators in the experimental group were significantly lower than those in the control group ($P<0.05$). The proportion of patients in the experimental group who needed to take analgesic measures in accordance with the modified facial pain scale (FPS-R) score was significantly lower than that in the control group at postoperative wakefulness and 2 h after surgery ($P<0.05$). Meanwhile, no statistically significant difference was observed between the groups at 24 h after surgery ($P>0.05$). The proportion of patients in the experimental group who needed to take analgesic measures on the basis of the parent postoperative pain measurement (PPPM) score was significantly lower than that in the control group when they were awake after surgery ($P<0.05$). No statistically significant difference was found between the groups at 2 and 24 h after surgery ($P>0.05$). Moreover, no statistically significant difference was observed in the incidence of adverse reactions between the two groups at 24 h after surgery ($P>0.05$). **Conclusion** The combination of local anesthesia during SECC dental treatment under general anesthesia results in minimal changes in intraoperative hemodynamics and mild postoperative pain response, hence worthy of clinical promotion.

[Key words] severe early childhood caries; general anesthesia; local anesthesia; pain management; hemodynamics

当前, 低龄儿童龋 (early childhood caries, ECC) 仍然是中国儿童口腔健康面临的重大挑战之一。我国第四次全国口腔健康流行病学调查结果显示, 3岁、4岁和5岁儿童患龋率分别为50.8%、63.6%和71.9%, 而充填率分别仅为1.5%、2.9%、4.1%^[1]。对于ECC患儿通常首选在非药物行为管理下进行治疗, 然而相当一部分患儿因年龄小、病情严重复杂, 如重度低龄儿童龋 (severe early childhood caries, SECC)、有牙科恐惧症或存在精神智力障碍等原因无法在非药物行为管理下完成治疗, 需接受药物行为管理^[2]。全身麻醉下口腔治疗技术作为一种有效的药物行为管理方式, 近年来被广泛应用于儿童口腔疾病的治疗^[3]。该项技术可一次性完成患儿口腔内所有患牙的治疗, 有效去除致龋微生物, 使口腔微生态趋于平衡, 快速改善患儿的咀嚼功能^[4]。其于1999年首次引入我国, 距今已有20余年的发展历史^[5]。

随着医学模式的转变, 舒适化诊疗理念正日益深入人心^[6]。患儿在全身麻醉下接受口腔治疗时, 一个值得关注的问题是全麻术中是否有需要辅助局部麻醉, 全身麻醉下患儿的意识水平降低, 对疼痛刺激反应降低, 那么在进行治疗操作时患儿是否完全无痛, 中华口腔医学会2021年发布的儿童口腔门诊全身麻醉操作指南指出, 全身麻醉起效后, 对于可致痛的口腔操作前, 推荐复合实施局部浸润麻醉或区域阻滞麻醉, 以减少全身麻醉药用量, 降低不良反应^[7]。然而也有文献^[8-9]指出额外给予局部麻醉对术后疼痛控制无作用, 并且能增加术后咬颊、咬唇、烦躁的发生率。

本回顾性研究旨在通过观察分析全身麻醉下SECC治疗联合使用局部麻醉术中不同术式的血流动力学变化、术后疼痛情况和术后不良反应的发生率, 为全身麻醉下SECC治疗联合使用局部麻醉提供参考。

1 材料和方法

1.1 研究对象

本回顾性研究已获得空军军医大学第三附属医院伦理委员会批准。选取2023年3—12月于空军军医大学第三附属医院儿童口腔科接受全身麻醉下口腔治疗的患儿108例。纳入标准:1) 患儿年龄6岁以下;2) 根据美国麻醉医师协会(American Society of Anesthesiologists, ASA)分级评估I类或II类;3) 口内龋失补牙面(decay-missing-filled surfaces, dmfs) ≥ 4 (3岁), dmfs ≥ 5 (4岁), dmfs ≥ 6 (5岁)。排除标准:1) 发育迟缓或认知功能受损;2) 存在严重全身系统性疾病;3) 对全身麻醉药物或局麻药物过敏。根据病历记录,将108例研究对象分为对照组($n=54$)和实验组($n=54$)。

1.2 麻醉过程

所有患儿常规禁食禁饮,无术前用药,在监护人陪伴下入室。吸入笑氧混合气、8%七氟醚,待患儿入睡后,将其平放于治疗台上。常规监测患儿心电图、血压、脉搏血氧饱和度、呼气末二氧化碳。开放静脉通路,静脉给予芬太尼2~3 $\mu\text{g}/\text{kg}$ 、丙泊酚2~2.5 mg/kg 、顺式阿曲库铵0.1~0.12 mg/kg 、地塞米松0.2 mg/kg 进行诱导,经鼻气管插管,咽腔放置纱布填塞,眼部放置眼罩遮挡。使用患者状态指数(patient state index, PSI)记录患儿术前麻醉深度。麻醉中使用2.5%~3%的七氟醚进行维持,治疗结束前20 min静注昂丹司琼2 mg以减少术后恶心和呕吐。实验组患儿在上述全身麻醉给药基础上,对每颗采用所研究4种术式(间接牙髓治疗术、牙髓切断术、根管治疗术、牙拔除术)的治疗牙在治疗前2 min给予2%利多卡因进行颊舌侧浸润注射,并记录给予局部麻醉药物的总量,不能超过4.4 mg/kg 。对照组患儿不给予局部麻醉药物。口腔治疗结束后,达到拔管标准后拔除气管导管,送患儿至恢复室,持续监测生命体征直至完全清醒,达到离院标准后方可离院。

1.3 观察指标

术中观察指标:每颗牙齿治疗过程中心率、收缩压、舒张压变化的最大值。

术后观察指标:采用修订版面部疼痛评分量表(facial pain scale revision, FPS-R)和术后父母疼痛测量量表(parent postoperative pain measure-

ment, PPPM)评估研究对象术后不同时刻(术后清醒时、术后2 h、术后24 h)的疼痛情况,并记录术后24 h内不良反应(咳嗽、恶心、呕吐、发热、嗜睡、烦躁)的发生率。FPS-R由反映儿童疼痛的6种面部表情组成,评分依次为0、2、4、6、8、10,其中0代表无疼痛,10代表极度疼痛,评分大于4的儿童被建议给予镇痛措施。PPPM量表由15个相关问题组成,监护人根据孩子的行为进行判断,回答“是”得1分,回答“否”得0分。当得分 ≥ 6 分时认为是显著疼痛,需要给予镇痛措施。镇痛措施统一为给予对乙酰氨基酚栓剂(150 mg)。

1.4 统计分析

采用SPSS 18.0软件对数据进行统计学分析。计量资料以 $\bar{x} \pm s$ 表示,计数资料以率表示。2组间身高、体重和年龄等连续变量的差异采用 t 检验;性别、根据FPS-R及PPPM给予镇痛措施的比率和术后不良反应的发生率的差异采用卡方检验。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 2组患儿的基本情况

本研究共纳入108例患儿,2组患儿的一般信息、麻醉用药量和术前麻醉深度差异无统计学意义($P > 0.05$),具体见表1。

表1 2组患儿基本情况比较

Tab 1 Comparison of basic information between children in the two groups

项目	对照组 ($n=54$)	实验组 ($n=54$)	χ^2/t 值	P 值
男:女	29:25	26:28	0.334	0.561
年龄/月	58.23 \pm 8.42	56.94 \pm 9.56	0.105	0.725
身高/cm	109.05 \pm 9.37	106.14 \pm 10.18	0.524	0.697
体重/kg	18.11 \pm 4.09	17.26 \pm 3.87	1.705	0.568
治疗牙数/颗	13.62 \pm 3.18	14.53 \pm 2.83	2.723	0.354
术前PSI	42.34 \pm 5.48	44.89 \pm 5.24	3.976	0.128
丙泊酚/mg	37.26 \pm 5.27	36.43 \pm 5.04	0.168	0.746
芬太尼/ μg	36.50 \pm 4.37	35.96 \pm 4.76	0.089	0.839
顺式阿曲库铵/mg	1.79 \pm 0.33	1.71 \pm 0.26	1.347	0.625
地塞米松/mg	3.61 \pm 0.59	3.42 \pm 0.49	2.145	0.427

2.2 2组患儿术中不同术式血流动力学变化

2组患儿术中不同术式血流动力学变化见表2,除间接牙髓治疗术3项观察指标的组间差异无统计学意义($P > 0.05$)外,牙髓切断术、根管治疗术和牙拔除术中,实验组的3项观察指标均显著小于

对照组 ($P<0.05$)。

表 2 2组患儿术中不同术式的流动力学变化

Tab 2 Hemodynamic changes during different procedures between children in the two groups

项目	对照组 (n=54)	实验组 (n=54)	t值	P值
间接牙髓治疗术				
心率变化/(次/min)	1.26±0.81	1.04±0.75	1.038	0.304
收缩压变化/mmHg	0.89±0.75	0.70±0.77	0.891	0.377
舒张压变化/mmHg	0.59±0.63	0.48±0.58	0.671	0.505
牙髓切断术				
心率变化/(次/min)	5.44±1.08	4.52±1.18	2.988	0.004
收缩压变化/mmHg	2.74±0.98	2.11±0.80	2.579	0.013
舒张压变化/mmHg	2.04±0.85	1.37±0.92	2.750	0.008
根管治疗术				
心率变化/(次/min)	4.78±1.31	4.04±1.28	2.097	0.041
收缩压变化/mmHg	2.59±1.01	1.81±0.92	2.956	0.005
舒张压变化/mmHg	2.22±1.12	1.56±1.05	2.255	0.028
牙拔除术				
心率变化/(次/min)	6.04±1.42	4.89±1.25	3.144	0.003
收缩压变化/mmHg	3.52±0.89	2.78±1.08	2.737	0.008
舒张压变化/mmHg	2.56±1.18	1.89±0.93	2.293	0.026

2.3 2组患儿术后疼痛情况及不良反应发生率

2组患儿术后疼痛情况及不良反应发生率见表3。实验组根据FPS-R评分需采取镇痛措施的比率在术后清醒时和术后2h显著小于对照组 ($P<0.05$)，术后24h组间差异无统计学意义 ($P>0.05$)。实验组根据PPPM评分需采取镇痛措施的比率在术后清醒时显著小于对照组 ($P<0.05$)，术后2h和术后24h组间差异无统计学意义 ($P>0.05$)。2组患儿术后24h不良反应发生率间差异无统计学意义 ($P>0.05$)。

表 3 2组患儿术后需采取镇痛措施比率及不良反应发生率

Tab 3 Rate of postoperative analgesia measures and incidence of adverse reactions between children in the two groups

项目	对照组 (n=54)	实验组 (n=54)	χ^2 值	P值
FPS-R				
术后清醒时	24 (44.44%)	14 (25.93%)	4.060	0.044
术后2h	19 (35.19%)	9 (16.67%)	4.821	0.028
术后24h	10 (18.52%)	6 (11.11%)	1.174	0.279
PPPM				
术后清醒时	22 (40.74%)	11 (20.37%)	5.280	0.022
术后2h	15 (27.78%)	8 (14.81%)	2.707	0.100
术后24h	9 (16.67%)	4 (7.41%)	2.186	0.139
术后24h不良反应	25 (46.30%)	20 (37.04%)	0.952	0.329

3 讨论

目前，SECC患儿患病年龄小、患病率高、治疗率低仍是我国儿童龋病一大特点^[10]。SECC治疗的难点在于如何进行有效的行为管理，随着口腔治疗技术的进步，以及社会对儿童身心健康的关注，儿童全麻下口腔治疗开展越来越广泛^[11]。本研究通过比较108例SECC患儿全身麻醉下进行口腔治疗联合使用局部麻醉术中不同术式的血流动力学变化、术后需采取镇痛措施比率和不良反应发生率，为全身麻醉下SECC治疗联合使用局部麻醉提供参考。

本研究中2组患儿的一般信息、麻醉用药量和术前麻醉深度差异无统计学意义，表明了2组患儿基线情况的可比性。脑电双频指数(bispectral index, BIS)是目前临床应用最广泛的用于监测患者麻醉深度的指标^[12-13]，而其应用于儿童麻醉深度监测的合理性已被大量研究^[14-16]证实。PSI使用基于4通道脑电图算法，反映脑电活动的许多维度的加权定量脑电图参数，提供来自大脑前后关系的功率、频率和相位信息以及双侧大脑区域之间的一致性，以同时反映全局和区域大脑状态变化^[17]。Chen等^[18]的研究结果表明PSI在意识水平变化方面可能比BIS具有更高的敏感性和更好的鉴别性能。而另有研究^[19]表明PSI和BIS在3岁以上儿童麻醉深度的监测中具有较好的一致性，故本研究通过PSI来评估2组患儿术前麻醉深度。

利多卡因自从1948年首次在临床上市后就一直是临床口腔治疗中最为广泛使用的酰胺类局部麻醉药，多年来，利多卡因一直被认为是口腔局部镇痛剂的金标准^[20]。阿替卡因是另一种酰胺类局部麻醉剂，它于1969年首次合成，与利多卡因相比，阿替卡因的效力是其1.5倍，毒性是其0.6倍^[21]。目前，阿替卡因已逐渐成为临床上儿童口腔医师应用局麻药物的首选^[22-23]，然而由于商品化成品中添加有肾上腺素^[24]，为了排除肾上腺素对于血流动力学的影响，本研究选择利多卡因作为实验局部麻醉药物。儿童全麻术中血流动力学的稳定性是手术安全的重要保障^[25]，有研究^[26-27]显示单独使用麻醉剂无法抑制疼痛性手术刺激引起的血流动力学反应，与本研究结果相一致，本研究中除间接牙髓治疗术外，实验组患儿在牙髓切断术、根管治疗术及牙拔除术中血流动力学变化均显著小于对照组患儿，表明局部麻醉药物的给予

利于患儿术中血流动力学的稳定。

疼痛是儿童日间全身麻醉下口腔治疗术后最常见并发症之一,发生率可高达至82%^[28]。早在20世纪90年代,英国口腔颌面外科医师协会就主张儿童及成人全身麻醉术中联合局部麻醉用药,可降低术后疼痛及心律失常的发生率^[29]。Lipp等^[30]研究结果也表明儿童全身麻醉下口腔治疗时,额外给予龈乳头浸润麻醉可有效降低儿童术后总体疼痛水平。然而也有研究^[31-32]结果显示联合使用局部麻醉对于接受全身麻醉口腔治疗儿童术后疼痛的减轻无效果。本研究结果显示实验组根据FPS-R评分需采取镇痛措施的比率在术后清醒时和术后2 h显著小于对照组,根据PPPM评分需采取镇痛措施的比率在术后清醒时显著小于对照组,表明全身麻醉下联合使用局部麻醉药在一定程度上利于患儿术后疼痛的减轻。

综上,本研究结果提示儿童全身麻醉下口腔治疗联合使用局部麻醉后,术中血流动力学变化较小,术后疼痛反应较轻,具有一定临床推广意义。本研究亦存在不足之处,由于本研究是回顾性研究,术后随访时间相对较短。同时,后续有待开展多中心随机对照研究,以提供级别更高的循证医学证据。

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[参考文献]

- [1] 中华口腔医学会儿童口腔医学专业委员会,中华口腔医学会口腔预防医学专业委员会. 婴幼儿龋防治指南[J]. 中华口腔医学杂志, 2021, 56(9): 849-856.
Society of Pediatric Dentistry, Chinese Stomatological Association; Society of Preventive Dentistry, Chinese Stomatological Association. Guideline on caries prevention and clinical practice for children under three years of age[J]. Chin J Stomatol, 2021, 56(9): 849-856.
- [2] Behavior Guidance for the Pediatric Dental Patient[J]. Pediatr Dent, 2018, 40(6): 254-267.
- [3] Pham L, Tanbonliong T, Dizon MB, et al. Trends in general anesthesia utilization by board-certified pediatric dentists[J]. Pediatr Dent, 2018, 40(2): 124-130.
- [4] Lin YJ, Lin YT. Influence of dental plaque pH on caries status and salivary microflora in children following comprehensive dental care under general anesthesia[J]. J Dent Sci, 2018, 13(1): 8-12.
- [5] 葛立宏. 全身麻醉下儿童牙齿治疗技术在我国应用现状及展望[J]. 口腔医学, 2016, 36(3): 193-196.
- [6] Ge LH. Current situation and prospect of dental treatment for children under general anesthesia[J]. Stomatology, 2016, 36(3): 193-196.
- [7] 邓锋, 郁葱. “舒适化口腔医疗”理念与规范化管理[J]. 重庆医学, 2012, 41(26): 2681-2682.
Deng F, Yu C. The concept and standardized management of “comfortable oral healthcare” [J]. Chongqing Med, 2012, 41(26): 2681-2682.
- [8] 中华口腔医学会镇静镇痛专业委员会. 儿童口腔门诊全身麻醉操作指南[J]. 中华口腔医学杂志, 2021, 56(3): 231-237.
Society of Sedation and Analgesia, Chinese Stomatological Association. Guideline on the use of general anesthesia for pediatric dentistry dental procedure[J]. Chin J Stomatol, 2021, 56(3): 231-237.
- [9] Townsend JA, Martin A, Hagan JL, et al. The use of local anesthesia during dental rehabilitations: a survey of AAPD members[J]. Pediatr Dent, 2013, 35(5): 422-425.
- [10] Watts AK, Thikkurissy S, Smiley M, et al. Local anesthesia affects physiologic parameters and reduces anesthesiologist intervention in children undergoing general anesthesia for dental rehabilitation[J]. Pediatr Dent, 2009, 31(5): 414-419.
- [11] 张静, 王雁. 中国学龄前儿童龋齿患病率及填充率的Meta分析[J]. 华西口腔医学杂志, 2023, 41(5): 573-581.
Zhang J, Wang Y. Meta-analysis of prevalence and filling rate of dental caries in preschool children in China [J]. West China J Stomatol, 2023, 41(5): 573-581.
- [12] Zhang B, Wang J, Han X, et al. Success rate of the treatment of early childhood caries under general anesthesia: a retrospective cohort study in different periods[J]. Front Pediatr, 2023, 11: 1117935.
- [13] Leslie K, Myles PS, Forbes A, et al. Recovery from bispectral index-guided anaesthesia in a large randomized controlled trial of patients at high risk of awareness [J]. Anaesth Intensive Care, 2005, 33(4): 443-451.
- [14] 岳云. 如何看待麻醉监测的临床与科学研究[J]. 临床麻醉学杂志, 2007, 23(7): 586-587.
Yue Y. How to view clinical and scientific research on anesthesia monitoring[J]. J Clin Anesthesiol, 2007, 23(7): 586-587.
- [15] Frelich M, Lečbychová K, Vodička V, et al. Effect of BIS-guided anesthesia on emergence delirium following

- general anesthesia in children: a prospective randomized controlled trial[J]. *Anaesth Crit Care Pain Med*, 2024, 43(1): 101318.
- [15] 潘守东, 冯艺, 马旭波, 等. BIS值监测患儿七氟醚复合氧化亚氮麻醉深度的准确性[J]. *中华麻醉学杂志*, 2010, 30(10): 1233-1235.
Pan SD, Feng Y, Ma XB, et al. Accuracy of BIS value for monitoring depth of sevoflurane-nitrous oxide anesthesia in children[J]. *Chin J Anesthesiol*, 2010, 30(10): 1233-1235.
- [16] 曲良超, 肖实, 郭善亮, 等. 脑电双频指数反馈调控丙泊酚靶控输注在小儿先心病手术中的应用[J]. *临床麻醉学杂志*, 2010, 26(5): 400-402.
Qu LC, Xiao S, Guo SL, et al. Application of BIS feedback-guided TCI propofol anesthesia in children undergoing surgery for congenital heart diseases[J]. *J Clin Anesthesiol*, 2010, 26(5): 400-402.
- [17] Drover D, Ortega HR. Patient state index[J]. *Best Pract Res Clin Anaesthesiol*, 2006, 20(1): 121-128.
- [18] Chen X, Tang J, White PF, et al. A comparison of patient state index and bispectral index values during the perioperative period[J]. *Anesth Analg*, 2002, 95(6): 1669-1674.
- [19] Jang YE, Kim EH, Lee JH, et al. Usefulness of bispectral index and patient state index during sevoflurane anesthesia in children: a prospective observational study [J]. *Medicine (Baltimore)*, 2022, 101(30): e29925.
- [20] Oliver G, David DA, Bell C, et al. An investigation into dental local anaesthesia teaching in united kingdom dental schools[J]. *SAAD Dig*, 2016, 32: 7-13.
- [21] Leith R, Lynch K, O'connell AC. Articaine use in children: a review[J]. *Eur Arch Paediatr Dent*, 2012, 13(6): 293-296.
- [22] Ezzeldin M, Hanks G, Collard M. United Kingdom pediatric dentistry specialist views on the administration of articaine in children[J]. *J Dent Anesth Pain Med*, 2020, 20(5): 303-312.
- [23] 韩欣欣, 杜祥, 赵辛, 等. 儿童口腔医生使用局部麻醉的现状调查[J]. *中华口腔医学研究杂志(电子版)*, 2020, 14(3): 164-170.
Han XX, Du Y, Zhao X, et al. The current status of local anesthesia used by pediatric dentists: a survey[J]. *Chin J Stomatol Res (Electron Ed)*, 2020, 14(3): 164-170.
- [24] 范俊霞. 新型口腔麻醉剂“碧兰麻”临床应用问答[J]. *中华口腔医学杂志*, 2001, 36(3): 218.
Fan JX. Clinical application questions and answers of the new oral anesthetic “Bilanma” [J]. *Chin J Stomatol*, 2001, 36(3): 218.
- [25] Foubert L, Reyntjens K, De Wolf D, et al. Remifentanyl infusion for cardiac catheterization in children with congenital heart disease[J]. *Acta Anaesthesiol Scand*, 2002, 46(4): 355-360.
- [26] Wilson IH, Richmond MN, Strike PW. Regional analgesia with bupivacaine in dental anaesthesia[J]. *Br J Anaesth*, 1986, 58(4): 401-405.
- [27] Zbinden AM, Petersen-Felix S, Thomson DA. Anesthetic depth defined using multiple noxious stimuli during isoflurane/oxygen anesthesia. II. Hemodynamic responses[J]. *Anesthesiology*, 1994, 80(2): 261-267.
- [28] Hu YH, Tsai A, Ou-Yang LW, et al. Postoperative dental morbidity in children following dental treatment under general anesthesia[J]. *BMC Oral Health*, 2018, 18(1): 84.
- [29] Rashad A, El-Attar A. Cardiac dysrhythmias during oral surgery: effect of combined local and general anaesthesia [J]. *Br J Oral Maxillofac Surg*, 1990, 28(2): 102-104.
- [30] Lipp K, Casamassimo P, Griffen A, et al. Effect of intra-papillary local anesthetic on postoperative pain following dental treatment under general anesthesia in pediatric patients[J]. *Anesth Prog*, 2021, 68(4): 206-213.
- [31] Macpherson A. Intra-operative local anaesthesia to reduce postoperative pain or distress in children after exodontia under general anaesthesia[J]. *Evid Based Dent*, 2007, 8(2): 45-46.
- [32] Moness Ali AM, Hammuda AA. Local anesthesia effects on postoperative pain after pediatric oral rehabilitation under general anesthesia[J]. *Pediatr Dent*, 2019, 41(3): 181-185.

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