International Journal of General Medicine

Dovepress
Taylor & Francis Group

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ORIGINAL RESEARCH

Correlation Analysis Between Real-Time Cerebral State Parameters and Emergence Agitation in Children Undergoing Decayed Tooth Surgery Under General Anaesthesia: Exploring Dental-Related Influencing Factors

Lin Li[1], Qinghua Meng[1], Aiping Tian[1], Ziwei Hao[2], Weizhi Zhang[1]

[1]Department of Anesthesiology, Shanxi Provincial Children's Hospital, Taiyuan, Shanxi Province, People's Republic of China; [2]Catheter Room, Shanxi Cardiovascular Hospital, Taiyuan, Shanxi Province, People's Republic of China

Correspondence: Weizhi Zhang, Department of Anesthesiology, Shanxi Provincial Children's Hospital, No. 13 Xinmin North Street, Taiyuan City, Shanxi Province, 030001, People's Republic of China, Tel +86 15234155563, Email weizhi96zhang@163.com

Objective: To analyse the correlation between real-time cerebral state index (CSI) and postoperative emergence agitation (EA) in children undergoing surgery for decayed teeth during recovery from general anaesthesia, and to explore the feasibility of CSI in predicting EA during perioperative care.

Methods: A retrospective case-control study was performed for paediatric patients who underwent radical surgery for decayed teeth under general anaesthesia at the Stomatology Outpatient Department of the Children's Hospital of Shanxi from January 2022 to December 2022. According to the presence or absence of EA in children during recovery from general anaesthesia, the enrolled patients were divided into two groups: the agitation group (Group A) and the non-agitation group (Group NA). All paediatric patients were monitored for CSI using a combined-type multifunctional monitor of HXD-I Multi-parameter Monitor after the induction of tracheal intubation under intravenous anaesthesia.

Results: There were 16 cases (40%) of EA among the affected children. At post-extubation (T6), the subcortical excitability index (SCEi) (95[71–99] vs 46[15–78]), cortical excitability index (CEi) (45[34–77] vs 32[10–49]) and anxiety index (ANXi) (49[41–58] vs 41[30–49]) of Group A were significantly higher than those of Group NA, while memory index (Mi) (10[8–14] vs 12[9–14]) was smaller than in the latter group, with statistically significant differences between groups ($P<0.05$). Additionally, as shown in the receiver operating characteristic curve, at T6, the area under the curve of SCEi, CEi, ANXi and Mi in predicting EA separately was 0.762, 0.771, 0.709 and 0.711, with sensitivity of 82.9%, 87.0%, 84.3% and 63.6%, and specificity of 70.4%, 43.5%, 46.8% and 77.2%, respectively.

Conclusion: Post-extubation SCEi, CEi, ANXi and Mi were significantly associated with EA occurrence in children undergoing decayed tooth surgery under general anaesthesia, with SCEi and ANXi showing relatively better predictive performance.

Keywords: cerebral state index, children, surgery for decayed teeth, emergence agitation, nursing

Introduction

Emergence agitation (EA) is a prevalent complication during the recovery phase of general anaesthesia, particularly among preschool children due to their notably higher incidence of this phenomenon.[1,2] Characterised by an inappropriate dissociation of behavioural and conscious states, EA manifests as excessive excitement, disorientation, confused consciousness, uncontrollable crying, moaning and even hallucinations.[3] Clinical statistics indicate that the incidence of EA post-general anaesthesia surgery can reach up to 55%, and in stomatological surgeries, this rate climbs to approximately 60%.[4,5] Despite its high prevalence, the underlying mechanism of EA remains unclear, with studies

Received: 14 July 2025
Accepted: 17 October 2025
Published: 19 November 2025

suggesting associations with multiple factors such as paediatric age, postoperative pain, preoperative anxiety and anaesthetic agents.[6] While sedative and analgesic medications can partially control EA, it remains a common clinical challenge, highlighting the urgent need for effective predictive tools to optimise perioperative management.

Electroencephalogram (EEG)-based monitoring has emerged as a promising approach to assess cerebral function during anaesthesia and predict postoperative neurobehavioral complications like EA. Previous research demonstrated that EEG frequency characteristics undergo significant changes during the awakening period: as patients transition from deep anaesthesia to awakening, the oscillation frequencies of δ and θ waves gradually decrease, while those of β and α waves increase, a shift that reflects the brain's transition from an inhibited to an awake state.[7] Analysing these EEG features, including frequency characteristics, power spectra and their correlations with behavioural states, offers valuable insights into the mechanisms of EA and provides a foundation for clinical prediction and intervention.[8]

Several EEG-derived parameters have been explored for their role in monitoring anaesthesia depth and predicting perioperative outcomes. The wavelet index (WLi), which integrates EEG parameters reflecting the degree of consciousness loss, has been shown to correlate well with bispectral index values, effectively monitoring intraoperative anaesthesia depth with an optimal range of 40–60. The pain threshold index (PTi), another key parameter, reflects the cerebral cortex's tolerance to painful stimuli. Additionally, parameters such as the subcortical excitability index (SCEi), delirium index (DELi), anxiety index (ANXi), cortical excitability index (CEi) and amnesia index (AMi) each capture distinct aspects of cerebral function, providing a comprehensive picture of brain states during anaesthesia.[9]

Gaps nonetheless exist in the existing literature, as well as controversies limiting EEG parameters' clinical use for EA prediction in paediatric decayed tooth surgery. Most studies have to date focused on adults or general paediatric surgeries, as opposed to the specific group included in this study and their unique factors such as dental phobia-related anxiety and short-acting anaesthetics, leaving parameter relevance unvalidated.[6] Optimal measurement timing is controversial, with few studying post-extubation (critical for early recovery), and no synthesis of parameters' collective role in EA risk.[10]

Against this backdrop, the present study aims to address these gaps by investigating the correlation between real-time cerebral state index (CSI) parameters (including SCEi, CEi, ANXi, and Mi) and EA in children undergoing decayed tooth surgery. By focusing on post-extubation (T5) parameters, we seek to identify the optimal timing for EA prediction. Additionally, we evaluate the predictive efficacy of individual and combined parameters to clarify their clinical utility. The findings of this study will not only fill the research gap in EEG-based EA prediction for paediatric dental surgery but also provide an evidence-based foundation for perioperative nursing, enabling early identification of children at high risk and the implementation of targeted interventions to reduce EA incidence.

Materials and Methods

Study Participants

This study was designed as a retrospective case-control study in accordance with the STROBE guidelines for observational studies. The data of paediatric patients who underwent radical surgery for decayed teeth under general anaesthesia at the Stomatology Outpatient Department of the Children's Hospital of Shanxi between January 2022 and December 2022 were retrospectively collected. The enrolled patients did not use any medication before surgery and were divided into two groups, based on the presence of EA during recovery from general anaesthesia, that is, the agitation group (Group A, n=16) and the non-agitation group (Group NA, n=24). The inclusion criteria were as follows: (1) aged 2–7 years; (2) grade ASA I or II; and (3) with complete electronic medical records and files, including current and past medical history, and detailed physical examination data. The exclusion criteria were as follows: (1) patients with severe cardiovascular diseases and severe organ dysfunction; (2) individuals with mental and intellectual disabilities; and (3) patients with respiratory, circulatory and other systemic diseases. This study was approved by the ethics committee of the hospital (No. IRB-KY-011).

Study Methods

Anaesthesia Method

All patients were fasted for 8 h and prohibited from drinking water for 2 h before surgery. The child was admitted to the room with open venous access to the upper limbs to ensure smooth follow-up treatment and monitoring. Blood pressure, electrocardiogram and pulse oximetry were also monitored. Anaesthesia induction was realised through intravenous infusion of Dezocin (0.1 mg/kg), propofol (3 mg/kg), remifentanil (3 μg/kg) and cisatracurium (0.15 mg/kg), in sequence. When spontaneous breathing stopped, patients were subjected to nasotracheal intubation. Following successful intubation, an anaesthesia machine was connected for constant pressure mechanical ventilation (FiO_2 80%, and I:E1:2). Anaesthesia maintenance adopted continuous intravenous infusion of propofol (8–10 mg/kg/h) and remifentanil (0.3–-0.5μg/kg/min) to maintain an intraoperative WLi and PTi of 40–60.

Cerebral State Index Monitoring

After successful tracheal intubation, the combined-type multifunctional monitor of HXD-I Multi-parameter Patient Monitor (Henan Xiangyu Medical Equipment Co., Ltd.,China) was used to collect EEG signals. After degreasing (using alcohol gauze to wipe the skin of the forehead and the bilateral retroauricular mastoid process of patients), the black electrode of the monitor was attached to the centre of the forehead (directly above the centre point of the eyebrows). Two white electrodes were attached to the upper region of the left eyebrow arch and the left mastoid process, respectively, and two red electrodes were attached to the upper region of the right eyebrow arch and right mastoid process, respectively. Using a dual-channel EEG signal acquisition sensor, we collected the pre-processing circuit of the prefrontal lobe's EEG signals; the EEG signals were obtained through steps such as multi-stage amplification, filtering and analogue-to-digital conversion to a digital signal. Real-time analysis of the collected EEG signals was performed using the wavelet algorithm-based EEG analysis software package (v1.0, Zuoyounao Medical Technology Group Co., Ltd., Nanjing, China) at a sampling frequency of 500/s, a 10-bit sampling accuracy and a 1.25 s time window, with the simultaneous calculation of various CSI parameters.[11]

Perioperative Care

Routine care in the perioperative period was carried out as follows. ① Individualised health education: the pathogenesis of the disease was explained in layman's terms to the family members of the child, as was the necessity for general anaesthesia and the necessary precautions taken. ② Vital signs monitoring: among others, the child's respiration, heart rate and colour were closely monitored, and their conscious state was checked every hour. ③ Dietary intervention: according to the child's recovery situation, they were given a nutritious fluid diet in a timely manner, then gradually transitioned to semi-liquid and general food.

Indicator Collection

General data collected for each child included pre-operative characteristics (age, weight, gender) and peri-operative time metrics (duration of surgery, total anaesthesia time, extubation time, and awakening time), all of which were recorded from the anaesthesia record immediately following the procedure. Scoring criteria for EA during recovery from general anaesthesia were recorded as follows: by calling to the patient using their name and stimulating, 0 points: patients opened their eyes and cooperated quietly; 1 point, patients opened their eyes and cried; 2 points, patients cried and did not cooperate. Patients were determined to have EA when scoring at least 1 point.[12] Total anaesthesia time: Defined as the duration "from the start of intravenous anaesthetic induction (time of the first propofol bolus injection) to the cessation of anaesthesia (time of stopping propofol and remifentanil infusion)", which was recorded accurately to the minute. Data were extracted from electronic anaesthesia records.

Primary outcome (CSI parameters): The CSI parameters were recorded after intubation (T1), 10 min after surgery (T2), 30 min after surgery (T3), at anaesthesia cessation (T4), after extubation (T5) and at awakening (T6). Next, the patient sedation index (WLi) was calculated: the sedation index reflected the degree of loss of consciousness of the patient during anaesthesia within a range of 0–100; a higher value indicated a shallower patient consciousness with a deeper degree of sedation. Analgesic index:[13] The PTi was used to assess the patient's sensitivity to pain, where the SCEi reflected the activity of the subcortical brain regions. The CEi reflected the activity level of the cerebral cortex, which is closely related to the patient's cognitive function and state of consciousness. The DELi was calculated based on EEG signals (used to assess the risk of postoperative delirium). The AMi was used to assess the recovery of the patient's postoperative memory function. The ANXi[14] was used to assess brainwave characteristics by analysing the patient's emotional state, especially anxiety level. The Mi[15] was used to assess the effect of the patient's memory on learning content.

Statistical Analysis

Statistical analysis in this study was conducted using the SPSS (IBM, Armonk, NY, USA) 26.0 software. The K–S test was used for normality, and the measurement data that met normal distribution are represented by ($\bar{x} \pm s$). Non-normally distributed data are presented as M (Q1, Q3), and inter-group comparisons were performed using an independent sample *t*-test and *U*-test, respectively. Statistical efficiency at a sample size of 40 cases was estimated using the G*power software (Heinrich-Heine-Universität Düsseldorf, Germany). The receiver operating characteristic (ROC) curve for the relevant indices was drawn to calculate the area under the ROC curve (AUC) of each index, and the optimal cutoff value was determined based on Youden's index. The significance of AUC differences was analysed by DeLong's test. A value of $P<0.05$ indicated a statistically significant difference. According to the existing sample size and p-threshold, the statistical power of all the analyses in this study was 75%–82%.

Results

Between-Group Comparison of the General Data

This study included 40 children with a male-to-female ratio of 23/17, a median age of 4 years and a body mass index (BMI) of 21.4±2.4. Among them, 16 cases were included in Group A and 24 cases in Group NA, with an EA incidence rate of 40.0%. As shown in Table 1, there were no statistically significant differences in terms of gender, age, BMI, duration of surgery, extubation time, total anaesthesia time and awakening time between the two groups ($P>0.05$).

Between-Group Comparison of the Cerebral State Index Parameters

At T1–T6, there was no statistically significant difference in comparisons concerning WLi, PTi, DELi and AMi between the two groups ($P>0.05$). At T6, the SCEi (95[71–99] vs 46[15–78]), CEi (45[34–77] vs 32[10–49]) and ANXi (49 [41–58] vs 41[30–49]) of Group A were significantly higher than those of Group NA; the Mi (10[8–14] vs 12[9–14]) was smaller than in the latter group, with statistically significant between-group differences ($P<0.05$) (see Table 2 and Figure 1).

Table 1 Comparison of General Data Between the Two Groups

Groups	Group A (n=16)	Group NA (n=24)	χ^2/*t*	*P* value
Male/Female (n)	9/7	14/10	1.893	0.432
Age (years)	3.8±1.3	4.0±1.3	1.539	0.083
BMI (Kg/m^2)	20.1±2.3	21.9±2.7	1.677	0.174
Duration of surgery (min)	62.3±20.5	59.8±17.7	3.102	0.074
Extubation time (min)	17.9±5.7	18.5±6.0	2.079	0.089
Awakening time (min)	26.9±6.7	28.3±7.1	2.712	0.054
Total anesthesia time (min)	114±27.4	108±24.9	1.526	0.081

Notes: Extubation: Extubation of superficial vein of upper extremity; Awakening: The patient regained consciousness of autonomy.

Table 2 Comparison of CSI Between the Two Groups at Different Time Points

Indexes	Groups	T1	T2	T3	T4	T5	T6
WLi[a]	Group A	50.3±11.6	52.4±5.1	53.6±5.2	54.9±9.7	66.0±5.9	70.7±5.4
	Group NA	51.6±11.4	52.8±10.6	54.4±6.8	56.8±8.4	65.9±7.8	69.8±6.0
PTi[a]	Group A	63.6±8.4	55.7±6.1	57.2±5.9	59.7±8.2	74.6±6.3	73.8±8.9
	Group NA	62.5±11.3	55.9±7.4	67.5±6.1	60.6±9.4	73.5±9.3	72.8±10.3

(*Continued*)

Table 2 (Continued).

Indexes	Groups	T1	T2	T3	T4	T5	T6
SCEi[b]	Group A	0(0~22)	14(10~21)	16(10~41)	18(11~55)	34(24~61)	95(71~99)
	Group NA	0(0~11)	12(8~20)	13(9~29)	14(9~38)	26(8~57)	46(15~78)*
CEi[b]	Group A	52(28~68)	17(15~36)	24(15~43)	33(16~62)	40(17~61)	45(34~77)
	Group NA	47(26~66)	28(14~57)	31(15~60)	39(18~65)	37(11~59)	32(10~49)*
DELi[b]	Group A	7(5~31)	3(1~9)	4(1~10)	4(1~14)	46(31~73)	14(10~42)
	Group NA	8(1~26)	2(1~8)	4(1~10)	4(1~11)	41(13~65)	21(13~35)
AMi[b]	Group A	41(18~63)	49(32~65)	38(17~60)	32(10~56)	64(39~77)	28(14~63)
	Group NA	44(17~65)	44(25~67)	36(21~57)	31(14~51)	66(55~85)	32(14~67)
ANXi[b]	Group A	2(1~9)	5(3~7)	6(4~10)	7(5~15)	50(25~59)	49(41~58)
	Group NA	6(1~12)	9(4~14)	8(4~13)	8(4~16)	43(17~56)	41(30~49)*
Mi[b]	Group A	7(5~13)	8(7~14)	9(7~11)	9(6~13)	9(7~13)	10(8~14)
	Group NA	7(5~14)	10(6~13)	11(8~12)	11(8~14)	12(8~13)	12(9~14)*

Notes: Compared with group A, *P<0.05. [a]repeated measures analysis of variance, [b]nonparametric test.
Abbreviations: WLi, Wavelet index; PTi, pain threshold index; SCEi, subcortical excitability index; CEi, cortical excitability index; DELi, delirium index; AMi, amnesia index; ANXi, anxiety index; Mi, and memory index; T1, after intubation; T2, 10 min after surgery; T3, 30 min after surgery; T4, at anesthesia cessation; T5, after extubation; T6, at awakening.

Predictive Performance of Cerebral State Index Parameters

The ROC curves were plotted based on SCEi, CEi, ANXi and Mi at T5. As shown in Table 3 and Figure 2, the AUC of SCEi, CEi, ANXi and Mi in terms of predicting EA separately was 0.762 (95%confidence interval [CI]: 0.642–0.879), 0.771 (95% CI: 0.659–0.867), 0.709 (95% CI: 0.573–0.872) and 0.711(95% CI: 0.566–0.870), with sensitivity of 82.9%, 87.0%, 84.3% and 63.6%, and specificity of 70.4%, 43.5%, 46.8% and 77.2%, respectively (P<0.05). The DeLong's test results showed that there were no significant differences in AUC between the SCEi and CEi (P=0.574), with a similar outcome indicated for results between the ANXi and Mi (P=0.511). There were significant differences in AUC between the SCEi and ANXi (P=0.005), between the SCEi and Mi (P=0.007), between the Cei and ANXi (P=0.009), and between the CEi and Mi (P=0.011).

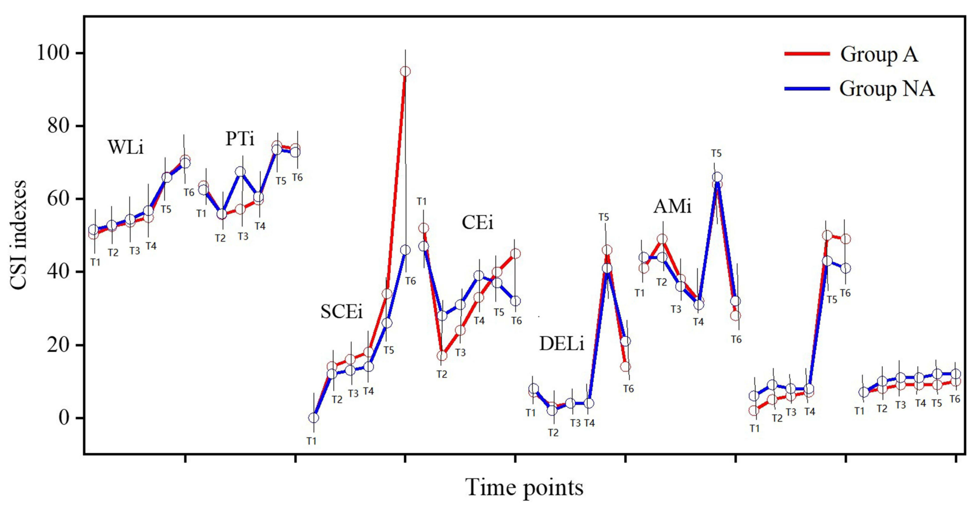

Figure 1 Trends in CSI index for both groups at different time points.

Table 3 The Effectiveness of SCEi, CEi, ANXi, and Mi in Predicting EA

Indexes	Cut-off Value	Sensitivity (%)	Specificity (%)	AUC (95% CI)
SCEi	72	82.9	70.4	0.762 (0.642~0.879)
CEi	24	87.0	43.5	0.771 (0.659~0.867)
ANXi	42	84.3	46.8	0.709 (0.573~0.872)
Mi	7	63.6	77.2	0.711 (0.566~0.870)

Abbreviations: SCEi, Subcortical excitability index; CEi, cortical excitability index; ANXi, anxiety index; Mi, memory index.

Discussion

This study focused on children undergoing surgery for decayed teeth, rather than those undergoing general surgical procedures. The core reason for this focus was that the occurrence of EA in this specific population is associated with unique factors such as "dental phobia" and "local oral stimulation". Additionally, their postoperative nursing needs are fundamentally different from those of children undergoing other types of surgeries. The finding of this study that "T5 SCEi and ANXi values can predict EA" was specifically proposed, based on the clinical characteristics of children undergoing surgery for decayed teeth. This finding can directly guide stomatological medical staff in formulating personalised recovery nursing plans, which reflects the clinical pertinence and necessity of the selection of research participants.

In this study, a combined-type multifunctional monitor was employed for the real-time monitoring of multiple CSI parameters in children undergoing surgery under general anaesthesia for decayed teeth. The wavelet algorithm,[16] currently recognised as the most suitable option for analysing EEG, was used to convert one-dimensional time-domain signals into three-dimensional time-amplitude-frequency signals. This approach enables achieving the most effective processing of EEG signals that are mixed together in the original time domain and, accordingly, difficult to detect in the transform domain, thereby facilitating additional calculation of different CSI parameters.[9,17] Wu et al showed that the PTi could effectively predict intraoperative haemodynamic fluctuations, while the SCEi, DELi, ANXi, CEi, AMi and CE reflected comprehensive EEG parameters of different brain states, respectively.[18,19]

According to the results of this study, there were no statistically significant differences in intraoperative WLi and PTi between the two groups, indicating that the occurrence of EA during the recovery period had no significant correlation

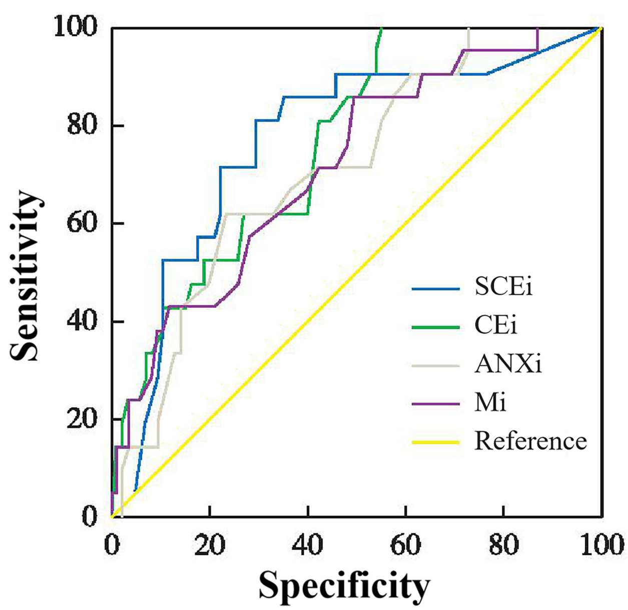

Figure 2 ROC curve of CSI-related indicators in predicting EA.

with the depth and intensity of anaesthesia. Meanwhile, the SCEi, CEi, ANXi and Mi in children with EA were significantly higher than those without EA. Further ROC analysis showed that the SCEi, CEi, ANXi and Mi could effectively predict the occurrence of EA during recovery from anaesthesia, with strong sensitivity. Children had a higher risk of experiencing crying or EA after awakening when the SCEi exceeded 74 and/or the CEi exceeded 23. In terms of explaining these outcomes, there may be differences in the recovery times of the cerebral central nervous system in children during recovery from general anaesthesia. Disinhibition of the subcortical centre when the cerebral cortex is still in an inhibitory state may result in focal sensitisation of the central nervous system.[10] The proposed absence of functional integrity can affect a child's response to external stimuli, and they may manifest excessive excitement in the central nervous system, leading to the occurrence of EA. The SCEi, CEi, ANXi and CFi were all effective in terms of predicting the occurrence of agitation during awakening from general anaesthesia, with the SCEi indicating the highest predictive efficacy. The lower specificity of the CEi and ANXi may imply the presence of a rate of misclassification among them in terms of distinguishing between patients who are agitated and those who are not, which may also be related to the small sample size of the present study. A study conducted by Zhang et al[20] found that cerebral state parameters were associated with emergence delirium in children undergoing general anaesthesia. However, this study did not focus on decayed tooth surgery and failed to analyse the predictive value of these parameters at the T5 time point. In contrast, the present study specifically targeted children undergoing surgery for decayed teeth and revealed that the SCEi and ANXi at T5 exhibited the highest predictive efficacy for EA, with an AUC of 0.762 and 0.709, respectively. This finding further expands the application of cerebral state parameters in perioperative anaesthetic nursing for stomatological procedures.

Although the CEi showed the highest AUC (0.771) and sensitivity (87.0%) among the four parameters, its specificity was only 43.5%, indicating a high rate of false-positive predictions (ie misclassifying non-agitated children as high-risk). In contrast, the SCEi achieved a more balanced performance, with an AUC of 0.762, sensitivity of 82.9% and specificity of 70.4%, while the ANXi (AUC=0.709, sensitivity=84.3%, specificity=46.8%) also outperformed the CEi in reducing false positives. This balance is critical for clinical practice, as it minimises unnecessary interventions and improves the accuracy of high-risk identification. The superior predictive efficacy of the SCEi and ANXi is closely associated with the characteristics of paediatric brain development and the pathophysiological mechanism of EA. In children, the cerebral cortex is immature, while subcortical structures such as the amygdala and thalamus exhibit relatively active functions.[4,7] The core pathology of EA lies in the dissociation between subcortical excitation and cortical inhibition during the recovery phase from general anaesthesia. The SCEi can directly reflect the excitatory state of the subcortex and accurately capture this dissociation, thus demonstrating stronger predictability compared to the WLi, which solely focuses on cortical function.[10] The ANXi is associated with the anxiety–stress neural circuit; stimuli such as oral manipulation and extubation activate this circuit, leading to the increased excitability of structures like the amygdala, and can thus reflect the emotional driving factors of EA. In contrast, the PTi only focuses on cortical pain tolerance and has a weak association with the emotion-related mechanisms of EA. Therefore, the SCEi and ANXi show more prominent predictive efficacy.[3,17] Additionally, in this study, the ANXi and Mi showed relatively slow and stable changes during recovery from anaesthesia. Accelerated values in the ANXi after extubation may indicate the disappearance of the residual effect of anaesthetic agents, and children may cry after awakening. In addition, the CEi represents the degree of recovery of hearing, touch and other senses after anaesthesia, which determines awakening from anaesthesia; additionally, an accelerated change in Mi can indicate an accelerated awakening process.[21,22] This highlights the significance of observing changes in CSI parameters such as SCEi, CEi, ANXi and Mi during recovery from general anaesthesia.

In children receiving general anaesthesia, EA is influenced by a variety of factors and is the result of multifactorial synergy. Some studies have shown that risk factors for EA in children include age, preoperative anxiety, anaesthetic drugs, surgical factors and pain.[23,24] In this study, we selected preschool children aged 2–7 years and completed surgery under the same anaesthetic conditions, controlling for the bias caused by age, anaesthetic drugs and surgical factors. It has been noted[25] that for every 10-point increase in preoperative anxiety score, the likelihood of EA in the child undergoing surgery increases by 10%. Urits et al showed that preoperative anxiety in parents and children increased the incidence of agitation during the awakening period from general anaesthesia.[5,26] The results of this study found that the differences between the two groups concerning the WLi, PTi, DELi, and AMi parameters were not statistically significant at most time points (T1-T5). However, a statistically significant difference was observed at T6. The effects of drugs like remifentanil (used in this study) may peak or wane at specific time points, thus affecting the onset of agitation. Children may be in the phase of waning or recovery from the effects of anaesthetic drugs at T6, resulting in significant changes in the agitation scores. Furthermore, a study by Zhang et al showed[27] that remifentanil may have a significant effect on the agitation score at T5, which is similar to the findings of the present study.

This study has some limitations. Due to the limited study time and small sample size, the results may include a degree of bias. Additionally, influencing factors such as preoperative anxiety status, choice of anaesthesia and medication, type of surgery and pain were not collected; therefore, multivariate logistic regression analysis could not be performed in this study. Additionally, the SCEi, CEi, ANXi and Mi have not been widely established and require further validation, while the use of simplified EA scoring methods may affect accuracy. A large number of clinical studies are needed for further confirmation of this study's results.

Conclusion

In this retrospective observational study, the T5 SCEi, CEi, ANXi, and Mi results were significantly associated with the occurrence of EA in children undergoing surgery for decayed teeth under general anaesthesia, with the SCEi and ANXi showing relatively better predictive performance. For children recovering from general anaesthesia after this type of surgery, monitoring the T5 SCEi and ANXi outcomes may help to identify those at potential high risk of postoperative EA, providing a preliminary reference for clinical nursing. However, due to the observational nature of the study, causal relationships could not be established, and the findings require cautious interpretation and validation through larger prospective studies.

Data Sharing Statement

All data generated or analysed during this study are included in this article.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Shanxi Provincial Children's Hospital (No.IRB-KY-011), and written informed consent was obtained from all parents/local guardians.

Consent for Publication

The manuscript is not submitted for publication or consideration elsewhere.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

Clinical Research Project of Shanxi Medical Doctor Association (YSXH-RF2022MZ003).

Disclosure

The authors report no conflicts of interest in this work.

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