Patient Selection for Locoregional Anesthesia in Pediatric Hand and Upper-Extremity Surgery: The Role of Age, Child Anxiety, and Parental Anxiety

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Abstract

Aim/Objective: The aim of this study was to identify the clinical and anxiety characteristics associated with the selection of locoregional versus general anesthesia in children undergoing hand and upper-extremity surgery. We hypothesized that older age, lower preoperative child anxiety, and lower parental anxiety would be associated with selection for locoregional anesthesia. **Methods:** This study was designed as a retrospective cohort study. A total of 101 pediatric patients who underwent hand and upper-extremity surgery at a single center between 2005 and 2019 were included and categorized into three age groups (3–7, 7–11, and 11–15 years). Anesthetic technique (locoregional, n=51; general, n=50) was selected according to routine clinical practice. Child anxiety was assessed with the modified Yale Preoperative Anxiety Scale (mYPAS) and parental anxiety with the State-Trait Anxiety Inventory-State form (STAI-1) preoperatively, immediately postoperatively, and on postoperative day 10. Groups were compared using the independent-samples t-test, Mann-Whitney U test, and chi-square test. **Results:** The proportion of patients managed under locoregional anesthesia increased with age: 33.3% in the 3–7-year, 50.0% in the 7–11-year, and 67.7% in the 11–15-year group (p=0.027). Preoperative mYPAS scores (13.2±1.4 vs. 17.4±1.2) and parental STAI-1 scores (50.3±5.4 vs. 60.9±6.4) were lower in the locoregional group (both p<0.001), consistently across all age strata. Mean operative duration was shorter in the locoregional group (47.5±25.4 vs. 58.8±27.8 min; p=0.036), a difference driven by the 3–7-year group. One additional patient planned for locoregional anesthesia required conversion to general anesthesia because of unexpectedly prolonged surgery. **Conclusions:** In light of these findings, it was concluded that locoregional anesthesia is feasible in selected children undergoing hand and upper-extremity surgery, particularly older children with low child and parental anxiety undergoing procedures of short expected duration. Realistic estimation of operative time is essential before choosing this technique. Prospective studies with multivariable analysis are needed to define objective selection criteria.

Keywords: Anesthesia, Conduction, Anxiety, Parents, Patient Selection, Hand/surgery

1. Introduction

Local anesthesia has gained increasing acceptance in hand surgery because it eliminates the systemic risks of general anesthesia, reduces perioperative preparation time, and lowers healthcare costs[1,2]. The wide-awake local anesthesia no-tourniquet (WALANT) technique has been the main driver of this shift in adult practice[1]. Interest in extending locoregional approaches to the pediatric population has grown accordingly[3-5].

Applying locoregional anesthesia in children is more challenging than in adults. Younger children are often anxious and may not cooperate during an awake procedure[3]. Preoperative anxiety is clinically important: it has been associated with behavioral problems, increased postoperative pain, and higher analgesic requirements[5,6]. Parental anxiety adds further complexity, as it has been shown to correlate with child anxiety in the perioperative setting[7]. Both the child's and the parent's anxiety profiles must therefore be considered when selecting an anesthetic technique.

Validated tools exist to measure these anxiety profiles. The modified Yale Preoperative Anxiety Scale (mYPAS) is widely used to assess preoperative anxiety in children and has been validated in Turkish[8,9]. Parental anxiety can be evaluated with the State-Trait Anxiety Inventory-State form (STAI-1)[10].

Despite growing interest in locoregional anesthesia for pediatric hand surgery, few studies have examined how age and anxiety profiles together influence patient selection[3-5]. This study evaluated 101 pediatric patients who underwent hand and upper-extremity surgery at a single center over 15 years. We aimed to identify the clinical and anxiety characteristics of children selected for locoregional versus general anesthesia. We hypothesized that older age, lower preoperative child anxiety, and lower parental anxiety would be associated with selection for locoregional anesthesia

2. Materials and Methods

2.1. Study design and setting

This retrospective cohort study was conducted at Yeniyüzyıl University Gazi-osmanpaşa Hospital. Pediatric patients who underwent hand and upper-extremity surgical procedures between January 2005 and December 2019 were included.

2.2. Patient population

Medical records were reviewed for all pediatric patients who underwent surgery during the study period. Patients were categorized into three predefined age groups: 3–7 years, 7–11 years, and 11–15 years. Only patients with complete operative records and available perioperative anxiety assessments were included. The final cohort consisted of 101 patients.

2.3. Anesthetic groups

Patients were managed under either locoregional or general anesthesia. In this study, locoregional anesthesia refers to any non-general anesthetic technique performed without airway manipulation, including local infiltration anesthesia, axillary nerve block, and WALANT. The decision between locoregional and general anesthesia was made according to routine clinical practice, based on patient age group, anticipated cooperation, procedure type, expected duration, and the preoperative anxiety profiles of both the child and the parent. No patient in the final cohort required intraoperative conversion from locoregional to general anesthesia.

2.4. Surgical procedures

The cohort included a heterogeneous spectrum of hand and upper-extremity procedures: fracture treatment, tendon and nerve repair, nail-bed repair, soft-tissue procedures,

congenital anomaly corrections, infection drainage, and replantation-related interventions. Procedure types were recorded from the operative registry.

2.5. Anxiety assessment

Child anxiety was assessed using the modified Yale Preoperative Anxiety Scale (mYPAS), and parental anxiety was assessed using the State-Trait Anxiety Inventory-State form (STAI-1). Both instruments were recorded at three time points: preoperatively, immediately after surgery, and on postoperative day 10. Preoperative scores were considered during anesthetic decision-making. Postoperative assessments were analyzed to describe the short-term anxiety trajectory following surgery.

2.6. Data collection

The following variables were extracted from medical records: anesthetic group, age-group category, child mYPAS scores at all three time points, parental STAI-1 scores at all three time points, procedure type, and operative duration in minutes. Because archived data were recorded as predefined age-group categories rather than exact chronological age, all analyses were performed according to these three age strata.

2.7. Outcome measures

The primary outcome was the association of age-group category and preoperative anxiety profile with selection of locoregional anesthesia. Secondary outcomes were: comparison of child mYPAS and parental STAI-1 scores between groups at all three time points, operative duration, and successful completion of surgery without conversion to general anesthesia.

2.8. Statistical analysis

Statistical analyses were performed using Python 3.13.5 with the pandas, SciPy, and statsmodels libraries. Continuous variables are presented as mean ± standard deviation, and categorical variables as number and percentage. Normality was assessed using the Shapiro-Wilk test. Between-group comparisons were performed using the independent-samples t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. Categorical variables were compared using the chi-square test or Fisher's exact test. Subgroup analyses were performed within each predefined age group. A two-sided p value <0.05 was considered statistically significant.

2.9. Ethical approval

The study was approved by the Istanbul Nisantasi University Health Sciences Ethics Committee (decision no: SBETKK2025-01, dated January 6, 2025). Written informed consent was obtained from the parents or legal guardians of all participants.

3. Results

3.1. Patient flow

A total of 106 patients were initially evaluated. Five patients were excluded: two had incomplete perioperative records, two were unable to cooperate during preoperative assessment and were directly scheduled for general anesthesia without formal anxiety scoring, and one patient planned for locoregional anesthesia required intraoperative conversion to general anesthesia due to unexpectedly prolonged operative duration. This conversion case was excluded from the main analysis and is discussed separately below. The final cohort consisted of 101 patients: 50 in the general anesthesia group and 51 in the locoregional anesthesia group.

3.2. Intraoperative conversion

One patient initially selected for locoregional anesthesia required conversion to general anesthesia. This patient belonged to the 7–11-year age group and had borderline

preoperative mYPAS and parental STAI-1 scores. The procedure duration exceeded the preoperatively estimated time, and the patient became uncooperative as the surgery extended. This case illustrates that even in appropriately selected patients, unanticipated prolongation of operative duration may compromise the feasibility of locoregional anesthesia and underscores the importance of realistic procedural time estimation during patient selection.

3.3. Patient distribution

Age-group distribution differed significantly between the two groups (p=0.027). The proportion of patients managed under locoregional anesthesia increased with age: 33.3% in the 3–7-year group, 50.0% in the 7–11-year group, and 67.7% in the 11–15-year group (Table 1).

Table 1. Baseline distribution of patients according to age group and anesthetic technique.

Variable	Total (n=101)	General anesthesia (n=50)	Locoregional anesthesia (n=51)	p value
Age group, n (%)				**0.027**
3–7 years	30 (29.7)	20 (66.7)	10 (33.3)	
7–11 years	40 (39.6)	20 (50.0)	20 (50.0)	
11–15 years	31 (30.7)	10 (32.3)	21 (67.7)	
Operative duration, min	53.1 ± 27.0	58.8 ± 27.8	47.5 ± 25.4	0.036
Conversion to GA, n (%)	0	–	0	–

Data are presented as number (%) or mean ± standard deviation. Comparisons performed using chi-square test for categorical variables and independent-samples t-test for continuous variables

3.4. Operative duration

Mean operative duration was significantly shorter in the locoregional anesthesia group than in the general anesthesia group (47.5 ± 25.4 min versus 58.8 ± 27.8 min; p=0.036). In the age-stratified analysis, this difference was significant only in the 3–7-year group (33.3 ± 13.4 min versus 66.4 ± 35.7 min; p=0.001) and was not significant in the 7–11-year (p=0.127) or 11–15-year (p=0.456) groups (Table 3). The shorter operative duration in the locoregional group likely reflects the selection of less complex procedures for awake surgery rather than a direct effect of the anesthetic technique itself.

3.5. Child anxiety scores

Preoperative mYPAS scores were significantly lower in the locoregional anesthesia group at all three time points (preoperative: 13.2 ± 1.4 versus 17.4 ± 1.2; immediate postoperative: 9.8 ± 1.2 versus 16.2 ± 1.1; postoperative day 10: 9.4 ± 1.2 versus 15.9 ± 1.7; all p<0.001) (Table 2). This pattern was consistent across all three age strata in the subgroup analysis (all p<0.001) (Table 3).

Table 2. Overall comparison of child and parental anxiety scores between anesthetic groups.

Variable	General anesthesia (n=50)	Locoregional anesthesia (n=51)	p value
Child mYPAS, preoperative	17.4 ± 1.2	13.2 ± 1.4	<0.001
Child mYPAS, immediate postoperative	16.2 ± 1.1	9.8 ± 1.2	<0.001
Child mYPAS, postoperative day 10	15.9 ± 1.7	9.4 ± 1.2	<0.001
Parental STAI-1, preoperative	60.9 ± 6.4	50.3 ± 5.4	<0.001
Parental STAI-1, immediate postoperative	59.4 ± 6.3	46.3 ± 4.9	<0.001

Variable	General anesthesia (n=50)	Locoregional anesthesia (n=51)	p value
Parental STAI-1, postoperative day 10	58.7 ± 5.6	44.1 ± 4.5	<0.001

Data are presented as mean ± standard deviation. mYPAS = modified Yale Preoperative Anxiety Scale; STAI-1 = State-Trait Anxiety Inventory-State form. Comparisons performed using independent-samples t-test.

3.6. Parental anxiety scores

Preoperative STAI-1 scores were significantly lower in the locoregional anesthesia group at all three time points (preoperative: 50.3 ± 5.4 versus 60.9 ± 6.4; immediate postoperative: 46.3 ± 4.9 versus 59.4 ± 6.3; postoperative day 10: 44.1 ± 4.5 versus 58.7 ± 5.6; all p<0.001) (Table 2). This finding was consistent across all age groups (all p<0.001) (Table 3). Postoperative and day-10 scores are reported as indicators of short-term anxiety trajectory and are not interpreted as predictors of future anesthetic preference.

Table 3. Age-stratified comparison of preoperative anxiety scores and operative duration.

Variable	General anesthesia	Locoregional anesthesia	p value
3–6 years			
Child mYPAS, preoperative	17.4 ± 1.3	12.2 ± 1.3	<0.001
Parental STAI-1, preoperative	60.6 ± 8.7	50.5 ± 2.4	<0.001
Operative duration, min	66.4 ± 35.7	33.3 ± 13.4	0.001
7–11 years			
Child mYPAS, preoperative	17.6 ± 1.3	14.0 ± 1.4	<0.001
Parental STAI-1, preoperative	62.9 ± 4.1	54.2 ± 2.9	<0.001
Operative duration, min	55.6 ± 22.8	45.5 ± 18.0	0.127
12–15 years			
Child mYPAS, preoperative	16.9 ± 0.7	12.9 ± 1.1	<0.001
Parental STAI-1, preoperative	57.7 ± 2.3	46.4 ± 5.5	<0.001
Operative duration, min	49.9 ± 14.1	56.2 ± 32.2	0.456

Data are presented as mean ± standard deviation. Age-stratified comparisons performed between the general anesthesia and locoregional anesthesia groups within each predefined age category.

4. Discussion

The main finding of this study is that locoregional anesthesia was feasible in selected pediatric patients undergoing hand and upper-extremity surgery. Older age group, lower preoperative child anxiety, lower parental anxiety, and shorter operative duration were associated with selection for locoregional anesthesia. These findings support a patient selection-based approach rather than a universal preference for either anesthetic technique.

The proportion of patients managed under locoregional anesthesia increased consistently across age groups, from 33.3% in the 3–7-year group to 67.7% in the 11–15-year group. This pattern is consistent with previous data showing that younger age is associated with higher preoperative anxiety in children[11,12], and that anxiety decreases as age increases in the school-age population[13]. From a practical standpoint, older children are more likely to understand the procedure, tolerate the initial injection, and remain cooperative throughout surgery[11,12]. Age should therefore be considered a practical selection criterion rather than a simple demographic variable.

Children selected for locoregional anesthesia had significantly lower preoperative mYPAS scores across all age groups, and their parents had significantly lower preoperative STAI-1 scores. This finding suggests that lower anxiety in both the child and the

parent may not only characterize the locoregional group, but may represent one of the primary conditions that make locoregional anesthesia feasible. Preoperative anxiety has been associated with adverse behavioral changes, increased postoperative pain, and higher analgesic requirements[14]. If a child appears visibly anxious preoperatively, proceeding with locoregional anesthesia may not be appropriate. Our results support this clinical judgment and provide quantitative evidence for it.

Parental anxiety also played a consistent role. Parents of children in the locoregional group had lower STAI-1 scores at all three time points. High parental anxiety before surgery may impair a child's ability to cooperate during an awake procedure and may contribute to intraoperative distress[6]. Although maternal perception does not always accurately reflect the child's actual anxiety level[15], parental anxiety profiles should be incorporated into the anesthetic decision-making process.

Overall operative duration was significantly shorter in the locoregional group (47.5 versus 58.8 min; p=0.036). This difference was driven primarily by the 3–6-year age group and likely reflects the selection of less complex, shorter procedures for awake surgery rather than a direct effect of the anesthetic technique. The single intraoperative conversion in this cohort occurred precisely because operative duration exceeded the preoperative estimate: the patient became uncooperative as the procedure extended beyond the anticipated time. This observation directly supports operative duration as an independent selection criterion. Children may become bored or distressed during prolonged awake procedures[11], and realistic estimation of surgical time before the decision is made appears essential to avoid intraoperative failure.

mYPAS and STAI-1 scores remained significantly lower in the locoregional group at both the immediate postoperative and day-10 assessments. These findings should not be interpreted as evidence that locoregional anesthesia reduces anxiety or influences future anesthetic preference. Rather, they reflect the short-term anxiety trajectory of a group that was already selected on the basis of lower preoperative anxiety. Locoregional anesthesia, when applied to appropriately selected patients, was not associated with a worse postoperative anxiety profile in either the child or the parent.

4.1. Limitations

Several limitations must be acknowledged. First, the retrospective design limits causal interpretation. Because anesthetic technique was determined by clinical judgment rather than randomization, the two groups were systematically different from the outset — children in the locoregional group were selected precisely because they were older, less anxious, and expected to cooperate. This selection bias means that the superiority of locoregional anesthesia over general anesthesia cannot be inferred from these data. What can be concluded is that locoregional anesthesia is feasible and safe when appropriate selection criteria are applied. Second, the cohort included a heterogeneous spectrum of procedures, which may have independently influenced both operative duration and anesthetic choice. Third, the study spanned 15 years, during which surgical and perioperative practices may have evolved. Fourth, exact chronological age was unavailable for all patients, and analyses were therefore performed using predefined age strata. Finally, the sample size was modest, and a formal power analysis was not performed; the possibility of type II error in the subgroup analyses cannot be excluded.

5. Conclusion

Locoregional anesthesia can be used safely in selected children undergoing hand and upper-extremity surgery. Older age, lower child anxiety, lower parental anxiety, and shorter expected operative duration are the main factors for successful selection. One patient required conversion to general anesthesia because the surgery took longer than

expected, which shows that operative duration must be estimated carefully before choosing locoregional anesthesia. This technique should not replace general anesthesia in all children, but should be considered in patients with suitable age and anxiety profiles.

Ethical approval and informed consent: This study was approved by the Istanbul Nisantasi University Health Sciences Ethics Committee (decision no: SBETKK2025-01, dated January 6, 2025). It was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participants. Patient data were anonymized before analysis, and confidentiality was maintained throughout the study.

Conflicts of interest: The authors declare no conflicts of interest.

Use of AI tools: AI tools were used only for language editing.

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