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ORIGINAL RESEARCH

Is Intravenous Access Necessary in Pediatric Patients Undergoing Ophthalmologic Examinations Under Anesthesia? A Prospective Observational Study

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Purpose: Ophthalmologic examinations under anesthesia (EUA) were employed in pediatric patients due to lower cooperation levels and associated discomfort during comprehensive eye examinations. There remains uncertainty regarding the necessity of intravenous (IV) placement during general anesthesia. The primary aim of the study is to investigate the impact of general anesthesia, with and without IV access, on operation time in pediatric patients undergoing EUA. Secondary objectives include assessing cardiovascular and respiratory complications and measuring parental satisfaction in both the IV and No IV groups.

Patients and Methods: This prospective observational analytic study, conducted as a cross-sectional study, took place between October 2019 and October 2020, in Department of Anesthesiology, Faculty of Medicine, Khon Kaen University, Thailand. We included healthy pediatric patients aged 2 to 7 years undergoing elective ambulatory EUA.

Results: Eighty-two patients, with 41 in the IV group and 41 in the No IV group, were enrolled and included for analysis. The No IV group showed a significantly shorter median operation time (7.99 (6.63, 9.36) minutes) compared to the IV group (10.9 (9.05, 12.28) minutes), with a median difference of −2.74 minutes (95% CI −3.76, −1.69, $p < 0.001$). In both groups, no cardiovascular or respiratory complications occurred, and there was no need for emergency IV access or drug administration. Children without IV access had higher parental satisfaction in extreme satisfaction (100% vs 48.78%; $p < 0.001$).

Conclusion: Providing general anesthesia for EUA without IV access in healthy pediatric patients, leading to shorter operation times and heightened parental satisfaction, can be conducted safely.

Clinical Trial Registration Number: The trial registration number is TCTR20191021001 from the Thai Clinical Trials Registry.

Keywords: anesthesia, catheters, examinations, eye, operative, pediatrics, time

Introduction

Ophthalmologic examinations under anesthesia (EUA), which are brief procedures, were conducted in pediatric patients due to their lower levels of cooperation and the associated discomfort during comprehensive eye examinations, such as in cases of retinoblastoma.[1–3] Most ambulatory pediatric procedures use a spontaneous breathing inhalation technique. Intravenous (IV) access is established after achieving adequate anesthesia depth and airway management with a face mask or laryngeal mask airway (LMA).[1]

The ongoing debate concerns whether IV access is necessary for general anesthesia in pediatric patients.[4] The benefit of IV access allows for perioperative fluid and drug administration, as well as blood component delivery, especially in

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emergency conditions such as laryngospasm, bronchospasm, anaphylaxis, arrhythmias, excessive blood loss, and other complications.[3,5] Alternative routes for emergency drug administration in situations lacking IV access include intramuscular (IM) and intraosseous (IO) options for managing these events.[4] It's worth noting that performing IV access in pediatric patients is not without risk, with difficulties arising from smaller veins, body habitus, and excessive subcutaneous fat.[3] Adverse events during IV access, such as discomfort, subcutaneous infiltration, infection, or potential parental dissatisfaction, may occur if multiple venipunctures are necessary.[5,6] Previous studies indicate that general anesthesia for minor procedures without IV access in pediatric patients during EUA,[3,7] myringotomy with tubes[8] or dental procedures[9] can be safely conducted with experienced assistance.[10] This approach not only reduces operation time, induction time, recovery time, and total hospital time but also enhances parental satisfaction.[5,8]

Regarding pediatric patients undergoing EUA procedures, general anesthesia without IV access showed both absence of complications[7] and occurrence of minor complications, all resolving safely without long-term sequelae.[3] However, there is still no consensus on whether IV placement is always necessary during general anesthesia, especially for pediatric patients.

We hypothesize that general anesthesia for short and minor operations in pediatric patients may not necessitate IV access, potentially reducing operation time and enhancing parental satisfaction.

Therefore, the primary aim of the study is to investigate the impact of general anesthesia, with and without IV access, on the operation time in pediatric patients undergoing EUA. Secondary objectives include assessing cardiovascular and respiratory complications during intraoperative and postoperative period, and measuring parental satisfaction in both the IV and No IV groups.

Materials and Methods

Study Design

This prospective observational analytic study, conducted as a cross-sectional study, took place between October 3, 2019, and October 8, 2020, in Department of Anesthesiology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand. Approval was obtained from the Khon Kaen University Ethics Committee for Human Research (HE 621383) before the study commenced, in compliance with the Declaration of Helsinki. The analysis and presentation of the study were conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[11] The trial registration number is TCTR20191021001 from the Thai Clinical Trials Registry.

We included pediatric patients aged 2 to 7 years undergoing elective ambulatory EUA. Only healthy children, classified as American Society of Anesthesiologists physical status classification I or II, were enrolled in this study. Exclusion criteria comprised children with additional procedures during EUA, suspected difficult airway, a history of severe postoperative nausea and vomiting, a need for IV medication, and contraindications for inhalation agents.

After obtaining written consent from the parents, who were fully informed about the purpose of the trial, including detailed standard guidelines for adverse event management in our hospital, no premedication was given to the children in the preoperative area. Our hospital allowed all parents to accompany their children into the operating theatre for the initial induction of anesthesia. Once the children lost consciousness, the parents were then escorted out of the operating theatre. All anesthetics were administered by a staff anesthesiologist, an anesthesia resident, or a certified registered nurse anesthetist under the direct supervision of an anesthesiologist. The anesthetic induction was titrated up to 5–8% sevoflurane and an FiO_2 of 0.5 oxygen in nitrous oxide, with a total flow of 6 L/min administered via a face mask until the patient lost consciousness. After that, the anesthesiologist in charge of each room had the authority to choose whether to proceed with or without IV access. Anesthesiologists generally prioritize IV access due to concerns about intraoperative complications. After successfully administering IV in the group receiving IV or achieving an adequate depth of anesthesia in the No IV groups, airway management was carried out using a face mask or LMA, depending on the anesthesiologist in charge of each room's choice, following the routine practice for EUA. General anesthesia was maintained by an end-tidal concentration of 1–1.5 minimum alveolar concentration (MAC) of sevoflurane with an FiO_2 of 0.5 oxygen in air, with a total flow of 2–4 L/min. The operations of EUA were conducted by an ophthalmologist and ophthalmology residents at various levels. Once the EUA was completed, patients recovered from general anesthesia, and the LMA was removed. Children were then

transferred to the post-anesthesia care unit (PACU) for standard monitoring. Upon readiness for discharge, nurses removed the IV line (IV group). Before discharge at PACU, parents were asked to rate their satisfaction using a five-point Likert scale.

There are standard guidelines for the management of adverse events in our hospital. The safety criteria during the operation depend on the decision of the anesthesiologist in charge of each room. If perioperative complications occur, emergency assistance arrangements will be made. In patients without IV access, if there's a need for IV administration of drugs or fluids, subsequent IV access may be considered. Alternatively, medications can be administered via IM or IO routes if IV access cannot be promptly established. Furthermore, emergency and resuscitation medications such as succinylcholine (0.5–2 mg/kg IV, 3–4 mg/kg IM), atropine (0.01–0.02 mg/kg IV, 0.02–0.04 mg/kg IM), and epinephrine (0.01 mg/kg IV/IO, 0.1 mg/kg via endotracheal tube) are readily available in the operating room, having been standardized and prepared.

Data Collection

All study data were documented by a team of researchers (comprising nurses and residents) who were not assigned to the operating room on the day of data collection.

The first section assessed patient characteristics, encompassing age, gender, weight, height, American Society of Anesthesiologists physical status classification, diagnosis, operation, airway management, and data from the IV access group, including attempts at IV cannulation, successful IV insertion, site of IV insertion, the needle size, and complications of IV access. The second section assessed anesthetic time, including operation time, and recovery time. Operation time includes induction time, surgical time, and emergence time, starting from the initiation of anesthesia to recovery from anesthesia and the removal of the LMA. Induction time is defined from the beginning of anesthesia (including the timing to perform IV access in the IV group) to just before the start of the EUA. Surgical time is defined from the start to the end of the EUA. Emergence time is defined from the end of the EUA to recovery from anesthesia and the removal of the LMA. Recovery time is defined from after recovery from anesthesia and the removal of the LMA to the time of discharge. Total anesthetic time is the sum of operation time and recovery time, starting from the beginning of anesthesia to the time of discharge. The third section assessed cardiovascular and respiratory complications, their overall management, and the incidence of adverse events that required intraoperative IV access placement. These events include laryngospasm, bronchospasm, anaphylaxis, arrhythmias, and other complications that necessitate the administration of emergency drugs such as succinylcholine, atropine, epinephrine, or other medications. The fourth section measured parental satisfaction with their children's general anesthesia for EUA, before discharge at PACU, using a five-point Likert scale (1 = extremely dissatisfied; 2 = somewhat dissatisfied; 3 = neither satisfied nor dissatisfied; 4 = somewhat satisfied; 5 = extremely satisfied).

Statistical Analysis

The demographic data of the participants were presented using frequency and percentage for categorical variables and mean ± SD or median with interquartile range (IQR) for continuous variables. Categorical data was evaluated using the Chi-squared test or Fisher's exact test and presented as numbers and percentages. For continuous data, the Kolmogorov–Smirnov test was employed as the statistical test of normality. Continuous data that followed a normal distribution was analyzed using the independent sample *T*-test and presented as mean ± SD. For data with a non-normal distribution, the Mann–Whitney *U*-test was applied, and the results were presented as median (IQR). The magnitude of the median difference in anesthetic time between the groups was reported with a 95% confidence interval (CI), and statistical significance was considered for $p < 0.05$. All analyses were conducted using STATA version 10.1 (StataCorp, Texas, USA).

The estimated required sample size, as referenced in a prior study,[5] was 41 in each group. This calculation was based on a 5% significance level, 80% power, a standard deviation of 8, a difference in the mean durations of the operation time for both groups of 5 minutes, and a confidence level of 95%. The total population comprised 82 patients.

Results

A total of 82 patients were identified as having undergone elective ambulatory EUA. Eighty-two patients were enrolled and included for analysis (Figure 1). There were no patients who withdrew from the study, and there was no missing data.

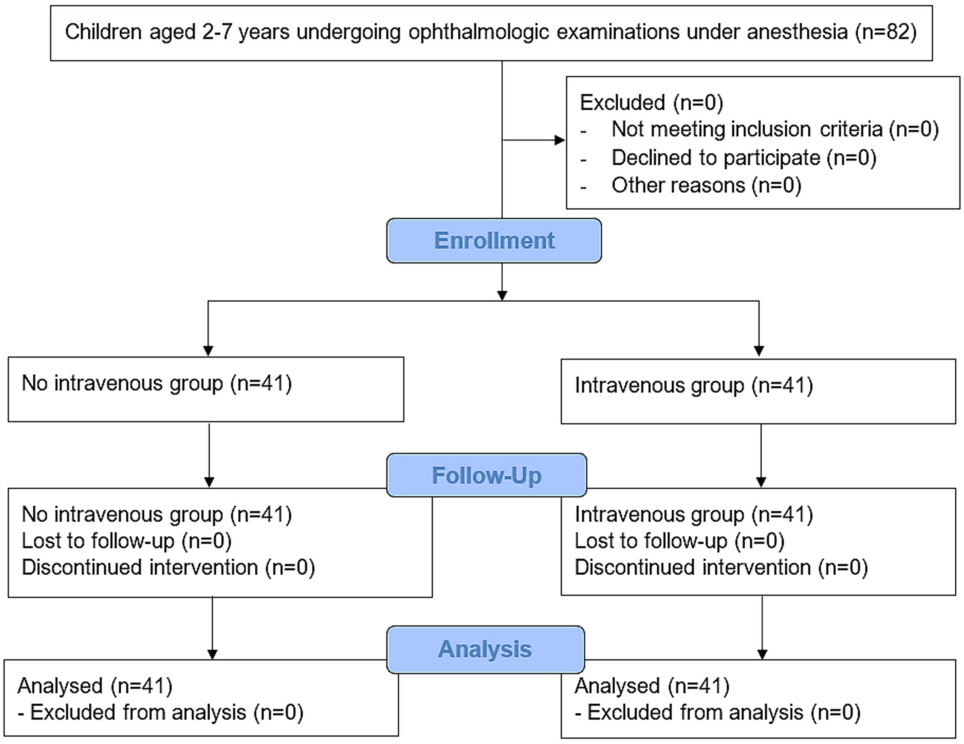

Figure 1 Study flow diagram.

Patient Characteristics

All of 82 patients were diagnosed with retinoblastoma with the American Society of Anesthesiologists physical status classification I. There are 41 patients in the IV group and 41 patients in No IV group. The demographic data show no significant differences between groups regarding age, gender, weight, height, American Society of Anesthesiologists physical status classification, underlying disease, and airway management (Table 1). Airway management involved the use of a face mask in 72 (87.8%) patients and a LMA in 10 (12.2%) patients.

In the IV group, successful IV access was achieved on the first attempt in 18 patients (43.9%) and on the second attempt in 12 patients (29.3%). However, 11 patients (26.8%) required three or more attempts. Notably, one patient needed nine attempts before success. The overall success rate for IV insertion was 92.7% in 38 patients. In three cases, IV insertion was attempted four times without achieving successful IV access. The wrist was the most common position for IV access, observed in 26 (68.4%) patients. The dorsum of the hand and foot were used for IV insertion in 9 (23.7%)

Table 1 Demographic Data

Variables	No IV Group (n=41)	IV Group (n=41)	*p*-value
Age (years; median (IQR))	2.92 (1.58, 3.67)	2.75 (1.75, 3.17)	0.673
Gender (n (%))			0.825
Male	21 (51.22)	20 (48.78)	
Female	20 (48.78)	21 (51.22)	
Weight (kg; median (IQR))	12 (9.1, 16)	12.9 (10.25, 14.50)	0.831
Height (cm; median (IQR))	90 (80, 99)	88 (81, 94)	0.669
Airway management (n (%))			0.092
Face mask	39 (95.12)	33 (80.49)	
Laryngeal mask airway	2 (4.88)	8 (19.51)	

Abbreviations: No IV group, No intravenous group; IV group, Intravenous group; IQR, interquartile range.

and 3 (7.9%) patients, respectively. The needle size used in all patients was 24G. Extravasation of fluid, an adverse event related to IV access, was observed in 4 (10.5%) patients.

Anesthetic Time

Table 2 reveals that the No IV group had a shorter median operation time at 7.99 (6.63, 9.36) minutes than the IV group (10.9 (9.05, 12.28) minutes), with a significant median difference of −2.74 (95% CI −3.76, −1.69, $p < 0.001$) minutes. In terms of induction time, the No IV group had a shorter median induction time at 2.90 (2.10, 4.30) minutes compared to the IV group (5.20 (4.28, 7.42) minutes), showing a significant median difference of −2.34 (95% CI −3.00, −1.54, $p < 0.001$) minutes. The medians for surgical time, emergence time, recovery time, and total anesthetic time did not exhibit a significant difference between the two groups.

Although the use of LMA may increase induction time and operation time, when comparing airway management with LMA or a face mask in the IV group and the No IV group, the results show no significant difference between the two groups (odds ratio 4.73, 95% CI 0.85, 47.88).

Cardiovascular and Respiratory Complications

In both groups, no cardiovascular or respiratory complications were observed during the intraoperative and postoperative periods. There was no need for emergency IV access in the No IV group or administration of drugs, including succinylcholine, atropine, epinephrine, or other medications in either group. Furthermore, analgesic and antiemetic agents were not required after the procedure in either group.

Parental Satisfaction

The No IV group had a significantly higher median parental satisfaction at 5 (5, 5) than the IV group (4 (4, 5)) on a five-point Likert scale, with a significant median difference of 1 (95% CI 0, 1, $p < 0.001$). Table 3 shows significantly higher

Table 2 Anesthetic Time

Anesthetic time (minute; median (IQR))	No IV Group (n=41)	IV Group (n=41)	Median Difference (95% CI)	*p*-value
Operation time	7.99 (6.63, 9.36)	10.9 (9.05, 12.28)	−2.74 (−3.76, −1.69)	<0.001*
Induction time	2.90 (2.10, 4.30)	5.20 (4.28, 7.42)	−2.34 (−3, −1.54)	<0.001*
Surgical time	3.78 (2.73, 4.18)	3.45 (3.15, 4.42)	−0.13 (−0.73, 0.45)	0.693
Emergence time	1.13 (0.80, 1.43)	1.33 (1.00, 1.75)	−0.2 (−0.44, 0.05)	0.129
Recovery time	60 (45, 65)	57 (50, 69)	−1 (−9, 6)	0.784
Total anesthetic time	67.19 (53.08, 74.36)	67.17 (60.05, 79.92)	−4.16 (−11.14, 3.05)	0.267

Note: *denotes significant *p*-value<0.05.
Abbreviations: No IV group, No intravenous group; IV group, Intravenous group; CI, confidence interval; IQR, interquartile range.

Table 3 Parental Satisfaction

Parental Satisfaction (n (%))	No IV Group (n=41)	IV Group (n=41)	*p*-value
Extremely satisfied	41 (100)	20 (48.78)	<0.001*
Somewhat satisfied	0 (0)	19 (46.34)	
Neither satisfied nor dissatisfied	0 (0)	1 (2.44)	
Somewhat dissatisfied	0 (0)	1 (2.44)	
Extremely dissatisfied	0 (0)	0 (0)	

Note: *denotes significant *p*-value<0.05.
Abbreviation: No IV group, No intravenous group; IV group, Intravenous group;

parental satisfaction in the No IV group, with 100% of parents reporting extreme satisfaction, compared to 48.78% in the IV group ($p < 0.001$). Two parents mentioned that retaining IV insertion may induce agitation in children.

Discussion

In our present study, we included 82 pediatric patients aged 2 to 7 years undergoing elective ambulatory EUA in the study. The No IV group showed significantly shorter operation times, higher parental satisfaction, and contributed to a reduced risk of cancellation for the remaining cases in the schedule, along with increased comfort at the PACU. In both groups, there were no cardiovascular or respiratory adverse events and no emergency IV access.

Various considerations, including the need for standardized anesthetic care, anesthesiologist preference, and parental concerns about postoperative nausea and vomiting, may require the placement of an IV in pediatric patients.[7] However, in cases where general anesthesia lacks IV access, effective alternative routes for emergency drug administration include IM and IO options for managing these events.[4]

Children with retinoblastoma require serial follow-up examinations and regularly return for EUA.[12] Repeated attempts for IV placement result in discomfort, financial inefficiencies, and contribute to waste in the healthcare system.[3] A study on peripheral IV attempts in pediatric patients found that 28% of the patients requiring three or more attempts consumed 43% of the group's total cost.[13] Similar to our study, 26.8% of the patients required three or more attempts, with one needing nine attempts for success. Additionally, three patients encountered four unsuccessful IV insertion attempts, leading the anesthesiologist in charge to proceed with the EUA procedure. However, no complications were reported. Therefore, choosing not to place an IV can lead to cost savings and reduced discomfort for pediatric patients.[3]

Our previous data indicated that from January 2016 to August 2018, 363 pediatric patients underwent EUA. However, our records did not include information about instances of difficult IV access during these procedures.

The present study shows that administering anesthesia for EUA without IV access in healthy pediatric patients can be done safely with experienced anesthesia teams, resulting in an almost 3-minute reduction in median operation time and a 2-minute reduction in median induction time. Similar to a previous study that administering anesthesia without IV access showed an almost 4-minute reduction in operation time,[5] and an almost 3-minute reduction in induction time.[8] However, the prior study showed that children without IV access experienced a significant reduction in Phase 2 recovery time and total hospital time.[5] This is different from the present study, which shows no difference in recovery time and total anesthetic time between the two groups. In our hospital's recovery protocol, all ambulatory patients were observed in the PACU for at least 60–120 minutes, depending on the clinical condition of the patients. Thus, patients in both groups exhibited no difference in recovery time and total anesthetic time. However, general anesthesia for EUA without IV access can decrease operation time and induction time, making it suitable for short operations like EUA, typically has 8–12 cases per half-day in our hospital.

Hung et al[3] reported that among the 5216 cases, 94% of EUA procedures were performed without IV access and 32% with the use of an LMA. There were 8 complications (0.15%), with 6 cases in the No IV group and 2 cases in the IV group. All complications resolved safely without long-term sequelae. Emergency IV access was successfully obtained in 5 cases and unnecessary in 1 case. However, it is worth mentioning that in 7 out of the 8 complications, the patient had an LMA placed before the complication occurred. The present study found that 50% were performed without IV access, 12.2% with an LMA. In both groups, no cardiovascular or respiratory adverse events were observed intraoperatively and postoperatively. There was no need for emergency IV access or administration of drugs. Furthermore, there was no requirement for analgesic or antiemetic agents following the procedure. Similar to the previous study, which reported that 92% of EUA procedures were performed without IV access, no patient undergoing anesthesia without an IV line experienced intraoperative adverse events requiring IV line insertion.[7]

The present study indicates a significantly higher level of parental satisfaction in the "extremely satisfied" category for the No IV group compared to the IV group (100% vs 48.78%, $p < 0.001$). Thus, the absence of IV access in children results in greater comfort, ultimately contributing to higher parental satisfaction.[5,6] Although we did not collect data on other factors influencing parental satisfaction, two parents mentioned that retaining IV insertion may induce agitation in children. Consistent with a previous study in myringotomy patients, parental satisfaction was significantly higher for children without IV access than for those with IV access (95% vs 28%, $p < 0.001$).[5]

Previous retrospective studies have suggested the safe administration of anesthesia for EUA without the necessity of inserting an IV line.[3,7] Our present study is a prospective observational analytic study with increased validity and no data loss. It demonstrates that administering anesthesia for EUA without IV access in healthy pediatric patients can be safely conducted by experienced anesthesia teams, leading to shorter operation time, as well as higher parental satisfaction.

Approach our findings cautiously due to various limitations. Ethical considerations influenced the design of our study as a prospective observational analytic study, which may introduce confounding factors. The study's single-setting nature and reliance on one experienced ophthalmologist may limit its applicability to other populations. Additionally, we did not assess for difficult IV access preoperatively. Anesthesiologists generally prioritize IV access due to concerns about intraoperative complications. Finally, the study's limited sample size makes it unlikely to detect rare complications. Further studies are suggested to be conducted in diverse settings, utilizing randomized controlled trials to minimize bias and enhance overall validity.

Conclusion

Providing general anesthesia for EUA without IV access in healthy pediatric patients can be conducted safely, leading to shorter operation times and heightened parental satisfaction.

Data Sharing Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Statement

Ethical approval was obtained from the Khon Kaen University Ethics Committee for Human Research (HE 621383).

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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.

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Disclosure

No potential conflict of interest relevant to this article was reported.

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References

1. Lewis H, James I. Update on anaesthesia for paediatric ophthalmic surgery. *BJA Educ*. 2021;21(1):32–38. doi:10.1016/j.bjae.2020.09.002

2. Ancona-Lezama D, Dalvin LA, Shields CL. Modern treatment of retinoblastoma: a 2020 review. *Indian J Ophthalmol*. 2020;68(11):2356–2365. doi:10.4103/ijo.IJO_721_20
3. Hung CW, Licina L, Abramson DH, Arslan-Carlon V. Anesthetic complications during general anesthesia without intravenous access in pediatric ophthalmologic clinic: assessment of 5216 cases. *Minerva Anestesiol*. 2017;83(7):712–719. doi:10.23736/S0375-9393.17.11565-8
4. Smith J. The placement of an intravenous cannula is always necessary during general anesthesia in children: a pro-con debate. The case against. *Paediatr Anaesth*. 2012;22(5):455–458. doi:10.1111/j.1460-9592.2012.03834.x
5. Haupert MS, Pascual C, Mohan A, Bartecka-Skrzypek B, Zestos MM. Parental satisfaction with anesthesia without intravenous access for myringotomy. *Arch Otolaryngol Head Neck Surg*. 2004;130(9):1025–1028. doi:10.1001/archotol.130.9.1025
6. Pettit J. Assessment of infants with peripherally inserted central catheters: part 2. Detecting less frequently occurring complications. *Adv Neonatal Care*. 2003;3(1):14–26. doi:10.1053/adnc.2003.50011
7. Vigoda MM, Latiff A, Murray TG, Tutiven JL, Berrocal AM, Gayer S. Can children undergoing ophthalmologic examinations under anesthesia be safely anesthetized without using an IV line? *Clin Ophthalmol*. 2011;5:503–508.
8. Allen AH. Is IV access necessary for myringotomy with tubes? *Ear Nose Throat J*. 2007;86(11):672–681. doi:10.1177/014556130708601118
9. MacMillan CS, Wildsmith JA. A survey of paediatric dental anaesthesia in Scotland. *Anaesthesia*. 2000;55(6):581–586. doi:10.1046/j.1365-2044.2000.01375.x
10. Wilson G, Engelhardt T. Who needs an IV? Retrospective service analysis in a tertiary pediatric hospital. *Paediatr Anaesth*. 2012;22(5):442–444. doi:10.1111/j.1460-9592.2010.03490.x
11. Strengthening the reporting of observational studies in epidemiology. Available from: https://www.strobe-statement.org/. Accessed September 19, 2024.
12. Saito T, Endo M, Hiraga K, Kaneko A. Clinical trial of fundoscopy under general anesthesia for pediatric outpatients with retinoblastoma. *Int J Clin Oncol*. 2004;9(1):36–41. doi:10.1007/s10147-003-0376-y
13. Goff DA, Larsen P, Brinkley J, et al. Resource utilization and cost of inserting peripheral intravenous catheters in hospitalized children. *Hosp Pediatr*. 2013;3(3):185–191. doi:10.1542/hpeds.2012-0089