Attitudes of Anesthesiology and Reanimation Specialists Towards Pediatric Anesthesia Outside of the Operating Room Practices: A Survey Analysis

Celaleddin Soyalp*, Nureddin Yüzкат

Department of Anesthesiology and Reanimation, Dursun Odabaş Medical Center, Van Yüzüncü Yıl University, Van, Turkey

ABSTRACT

There is a growing demand for safe and effective sedation/anesthesia of pediatric patients outside the operating room. This study was designed to investigate the practices and resources of pediatric anesthesia outside the operating room. A total of 219 anesthesiology and reanimation specialists (mean±SD age: 38.3±7.2 years, 50.7% female) voluntarily completed this online questionnaire survey. The questionnaire included items on demographic data, professional characteristics, type of hospital, and the characteristics of anesthesia applied outside the operating room.

Most respondents reported that they performed pediatric anesthesia outside the operating room frequently, ranging from a couple of days per week (47.2%) to every day (27.3%), mostly for MRI (87.7%), endoscopy (60.1%), pediatric angiography (58.9%) and biopsy (54.6%) procedures. Overall, 60.1% and 25.8% of the anesthetists stated that they use ASA criteria (inclusion of ASA I-II patients, 39.9%) and age criteria for candidacy, respectively. The professors were determined to be the group with the highest rates for the procedure (66.7%) on a daily basis, while state hospitals were associated with less frequent implementation of the procedure (p<0.001 for each).

In conclusion, this questionnaire-based survey revealed frequent and guideline-adherent application of pediatric anesthesia outside the operating room by anesthesiology and reanimation specialists. Together with the likelihood of professional training and hospital type influencing the frequency of the procedure and recovery strategies, these findings emphasize the need for improved practice regarding consideration of appropriate candidacy for ASA physical status and patient age as well as a uniform and standardized recovery practice among anesthesiology and reanimation specialists.

Key Words: Pediatric anesthesia outside the operating room; anesthesiology and reanimation specialists; adherence to guidelines; practices; resources

Introduction

In relation to financial pressures regarding the provision of more cost-effective and efficient healthcare, a variety of diagnostic and therapeutic procedures have become more commonly performed outside the operating room (1,2). In children, most of these procedures require sedation, analgesia or both to achieve the degree of co-operation or immobilization necessary to complete these procedures successfully (3). Hence, there is a growing demand for safe and effective sedation/anesthesia of pediatric patients for a multitude of surgical procedures outside the operating room (2,4-6).

Although specialists who are not anesthesiologists such as intensivists, emergency medicine physicians and hospitalists may also be involved in the provision of procedural sedation outside the operating room, the standards of care are set by the anesthesiology department and necessitates the involvement of an anesthesiologist either directly or indirectly (2,5,6).

Increased recognition of the importance of a multifaceted approach to pediatric sedation, the provision of focused and comprehensive training for all members of a procedural anesthesia team and utilization of pooled data on safety and outcomes after sedation are considered essential to create and maintain improved pediatric sedation services (6).

This questionnaire-based survey was therefore designed to investigate the practices and resources of anesthesiology specialists applying pediatric anesthesia outside the operating room.

Material and Methods

Study Population: The study included a total of 219 anesthesiology and reanimation specialists, comprising 50.7% females and 49.3% males with a
Table 1. Demographic data and professional characteristics of the participants

| Participant characteristics | mean(SD) | median (min-max) |
|-----------------------------|---------|-----------------|
| Age (years)                 | 38.3(7.2) | 37 (25-58) |
| Gender, n(%)                |         |                 |
| Male                        | 108(49.3) |                 |
| Female                      | 111(50.7) |                 |
| Professional title, n(%)    |         |                 |
| Specialist without academic position | 142(64.9) |         |
| Resident                    | 46(21.0)  |                 |
| Faculty member              |         |                 |
| Associate Professor         | 17(7.8)   |                 |
| Professor                   | 14(6.4)   |                 |
| Type of hospital, n(%)      |         |                 |
| University hospital         | 103(47.0) |                 |
| State hospital              | 56(25.6)  |                 |
| Training and research hospital | 46(21.0) |         |
| Private hospital            | 14(6.4)   |                 |
| Practice of pediatric anesthesia outside the operating room, n(%) | 163(74.4) | |
| Yes                         | 163(74.4) |         |
| Specialist without academic position | 89(62.7) |         |
| Resident                    | 45(97.8)  |                 |
| Faculty member              |         |                 |
| Associate Professor         | 16(94.1)  |                 |
| Professor                   | 13(92.9)  |                 |
| No                          | 97(25.6)  |                 |
| Specialist without academic position | 53(37.3) |         |
| Resident                    | 1(2.2)    |                 |
| Faculty member              |         |                 |
| Associate Professor         | 1(5.9)    |                 |
| Professor                   | 1(7.1)    |                 |

SD: standard deviation; min: minimum; max: maximum

mean age of 38.3±7.2 years, 50.7% were female. The participants voluntarily completed an online questionnaire, and a final analysis was made of 163 of the 219 physicians who confirmed the practice of anesthesia outside the operating room.

Written informed consent was obtained from each subject following a detailed explanation of the objectives and protocol of the study. Approval for the study was granted by the Ethics Committee of Van Yuzuncu Yil University ethics committee of clinical research (Date:13.02.2019 No:02).

Questionnaire: An e-mail invitation was sent to eligible physicians for participation in the survey, with access to the survey link with an identification number and log-in code to complete the online survey. The survey instrument consisted of 33 items exploring the approaches of the clinicians to pediatric anesthesia outside the operating room. The questionnaire included items on demographic data (age, gender), professional title, type of hospital, and characteristics related to the practice of anesthesia outside the operating room, including frequency per week, indications, American Society of Anesthesiology (ASA) physical status criteria for candidacy, age criteria for candidacy, use in emergency conditions, hospital conditions, use of premedication 1-day before the anesthesia, the role of parent/legal guardian, fasting period, the team members, available equipment, preferred method for anesthesia, use of regional anesthesia, preferred method for non-invasive monitorization, hypnotic agents used for sedo-analgesia, use of antagonism, preferred antagonist agent, place of recovery, most frequently encountered post-procedural complications and previous experience of patient death related to the procedure.

Study parameters: Characteristics related to the practice of anesthesia outside the operating room were evaluated in the overall study population and
### Table 2. Practices and resources for pediatric anesthesia outside the operating room (n=163)

| Pediatric anesthesia outside the operating room | n(%) |
|-------------------------------------------------|------|
| Frequency per week                              |      |
| Couple of days                                  | 76(47.2) |
| Every day                                       | 44(27.3) |
| On demand                                       | 31(19.3) |
| Rarely                                          | 10(6.2) |
| Indications                                     |      |
| MRI                                             | 143(87.7) |
| Endoscopy                                       | 98(60.1) |
| Pediatric angiography                           | 96(58.9) |
| Biopsy                                          | 89(54.6) |
| ESWL                                            | 67(41.1) |
| Wound care                                      | 33(20.2) |
| Physical examination                            | 32(19.6) |
| Other                                           | 26(16.0) |
| Use in emergency conditions                     |      |
| Total                                           | 117(71.8) |
| MRI                                             | 74(45.4) |
| Endoscopy                                       | 69(42.3) |
| Pediatric angiography                           | 53(32.5) |
| Biopsy                                          | 32(19.6) |
| ESWL                                            | 16(9.8) |
| Wound care                                      | 15(9.2) |
| Physical examination                            | 15(9.2) |
| Other                                           | 6(3.7) |
| ASA criteria for candidacy                       |      |
| None                                            | 65(39.9) |
| ASA I-II                                        | 64(39.3) |
| ASA I-III                                       | 28(17.2) |
| ASA I                                           | 6(3.7) |
| Age criteria for candidacy                       |      |
| None                                            | 121(74.2) |
| Exclusion of neonatal age group                 | 21(12.9) |
| Exclusion of <3 years age group                 | 13(8.0) |
| Exclusion of infantile age group                | 8(4.9) |
| Parent/legal guardian                           |      |
| Obtaining informed consent                      | 161(98.7) |
| Witness during procedure allowed                | 22(13.5) |
| Witness during procedure Never                   | 141(86.5) |
| Questioning the fasting period (yes)            |      |
| Yes                                             | 163(100.0) |
| Premedication 1-day before the anesthesia (yes) |      |
| Yes                                             | 53(32.5) |
| The team members                                |      |
| Anesthesia technician                           | 160(98.2) |
| Anesthesia specialist                           | 150(92.0) |
| Anesthesia nurse                                | 12(7.4) |
| Health officer                                  | 4(2.5) |
| Other                                           | 37(22.7) |
| Hospital conditions                             |      |
| Appropriate                                     | 125(77.6) |
| Not appropriate                                 | 38(23.3) |
| The room for procedure                          |      |
| Sufficiently large                              | 88(54.0) |
| Safe                                            | 60(36.8) |
| Available equipment*                            |      |
| Oxygen source                                   | 159(97.5) |
| Pulse oximetry                                  | 154(94.5) |
| Aspirator                                       | 152(93.3) |
| Emergency care bag                              | 149(91.4) |
| Monitor                                         | 146(89.6) |
| Crash cart                                      | 131(80.4) |
| Fixed line telephone                            | 122(74.8) |
| Anesthesia device                               | 102(62.6) |
| Defibrillator                                   | 60(36.8) |
| Pager                                           | 34(20.9) |
Soyalp and Yüzkat / Anesthesiologists’ attitudes towards pediatric anesthesia outside of the operating room

| Equipment check-list before the procedure | Available | 94(57.7) | Not available | 54(33.1) | No idea | 15(9.2) |
| Preferred method for anesthesia | Deep sedation | 132(81.0) | Conscious sedation | 88(54.0) | General anesthesia | 61(37.4) |
| Use of regional anesthesia | Yes | 16(9.8) | Peripheral blockade | 12(7.4) | Spinal anesthesia | 5(3.1) |
| | | | Epidural anesthesia | 3(1.8) | Caudal anesthesia | 2(1.2) |
| | | | Other | 11(6.7) |
| Preferred method for non-invasive monitorization | Pulse oximetry | 162(99.4) | ECG | 136(83.4) |
| | | | Non-invasive blood pressure | 101(62.0) |
| | | | ET CO2 | 54(33.1) |
| | | | Heat monitorization | 11(6.7) |
| Hypnotic agents used for sedoanalgesia | Midazolam | 154(94.5) | Propofol | 140(85.9) | Ketamine | 146(89.6) |
| | | | Thiopental | 43(26.4) | Etomidate | 2(1.2) |
| | | | Other | 11(6.7) |
| Use of antagonism | Always | 12(7.5) | Sometimes | 95(59.0) | Never | 54(33.5) |
| Preferred antagonist agent | Sugammadex | 65(39.9) | Flumazenil | 61(37.4) | Neostigmine | 41(25.2) |
| | | | Naloxone | 18(11.0) |
| Place of recovery | Recovery room | 75(44.8) | Same room as the procedure | 72(44.2) |
| | | | Waiting room | 12(7.4) |
| | | | Ward | 6(3.7) |
| Most frequently encountered post-procedural complications | Desaturation | 154(94.5) | Nausea/vomiting | 55(33.7) |
| | | | Brady-arrhythmia | 52(31.9) |
| | | | Hypotension | 19(11.7) |
| | | | Other | 4(2.5) |
| Previous experience of patient death during procedure | Yes | 4(2.5) | Due to anaphylaxis | 1(25.0) |
| | | | Due to hypoxia | 1(25.0) |
| | | | Due to respiratory arrest | 1(25.0) |
| | | | Due to high risk patient | 1(25.0) |

*Multiple choices were possible.

Statistical Analysis: Data obtained in the study were analyzed statistically using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Pearson Chi-square and Fisher-Freeman-Holton tests with Monte Carlo simulation technique and Benjamini-Hochberg correction were used to analyze categorical variables. Data were expressed as mean ± standard deviation (SD), median(min-max) values and number (n) and percentage (%) where appropriate. A value of p<0.05 was considered statistically significant.
Results

Demographic and Professional Characteristics of Participants: The study population comprised 50.7% females and 49.3% males with a mean age of 38.3 ±7.2 years. Most (52.1%) of the participating physicians were specialists without an academic position, and 14.2% were also faculty members. University hospitals (47.0%) were the most common type of hospitals, followed by state hospitals (25.6%) and training and research (21.0%) hospitals (Table 1). In total, 163 of 219 physicians stated that they practice pediatric anesthesia outside the operating room. The 56 respondents who reported that they do not perform pediatric anesthesia outside the operating room comprised 53 of 142 (37.3%) specialists without academic position, 1 of 46 residents, 1 of 17 associate professors and 1 of 14 professors (Table 1).

Practice of Pediatric Anesthesia Outside The Operating Room (N=163): Most of the participating physicians stated that they perform pediatric anesthesia outside the operating room frequently, ranging from a couple of days per week (47.2%) to every day (27.3%), mostly for MRI (87.7%), endoscopy (60.1%), pediatric angiography (58.9%) and biopsy (54.6%) procedures, including emergency conditions (71.8%) (Table 2).

Overall, 60.1% and 25.8% of physicians reported that they use ASA criteria (inclusion of ASA I-II patients, 39.9%) and age criteria (exclusion of neonatal age group, 12.9%) for candidacy, respectively. The majority of the physicians stated that they obtain informed consent from the parent/legal guardian of the patient prior to the procedure (98.7%) and do not allow the parent/legal guardian to witness the procedure (86.5%). All physicians reported that they questioned the fasting period and the use of premedication 1 day before the anesthesia was confirmed by 32.5% (Table 2).

Anesthesia technicians and anesthesia specialists were identified as the leading members of the team, hospital conditions were considered to be appropriate by 77.6% of physicians and the size of the room for the procedure was considered appropriate by 54.0%. Available equipment included an oxygen source pulse oximetry, aspirator, emergency care bag, monitor and crash cart in the majority of cases. An equipment check-list before the procedure was stated to be available only by 57.7% of the physicians (Table 2).

The majority of the physicians stated that they use deep sedation (81.0%), the preferred method for non-invasive monitoring to be pulse oximetry (99.4%) and ECG (83.4%), Midazolam (94.5%), propofol (85.9%) and ketamine (89.6%) were identified as the most common hypnotic agents used for sedoanalgesia. The use of regional anesthesia was reported by 9.8% (peripheral blockade in 7.4%) of physicians, while use of antagonism was stated by 66.5% (always in 7.5%, with sugammadex or flumazenil in ~40%) (Table 2).

The place of recovery after anesthesia was identified as the recovery room or the same room in which the procedure had been applied by 44.8% and 44.2% of physicians, respectively. Desaturation (94.5%), followed by nausea/vomiting (33.7%) and bradyarrhythmia (31.9%) were the most frequently encountered post-procedural complications, while previous experience of patient death during the procedure was reported by 4 (2.5%) physicians due to anaphylaxis, hypoxia, respiratory arrest or high risk patient (n=1 for each) (Table 2).

Practice of Pediatric Anesthesia Outside The Operating Room According To Professional Title: The professors were determined to be the group with the highest rates of applying these procedures (66.7%), and residents (4.5%) were the group with the lowest rates for performing pediatric anesthesia outside the operating room on a daily basis (p<0.001 for each). The use of regional anesthesia was more common among faculty members (25.0% for associate professors, 30.8% for professors) compared with residents (6.7%) and specialists without an academic position (5.6%) (p<0.01 for each) (Table 3).

The place of recovery was reported to be the recovery room by a higher percentage of associate professors (50.0%) and specialists (57.3%) than resident physicians (20.0%), while the same room was used for both anesthesia and recovery according to a higher percentage of residents than specialists (68.9% vs. 29.2%, p<0.01) (Table 3).

No significant difference was noted in the practice of pediatric anesthesia outside the operating room according to professional title in respect of the use of candidacy criteria, methods for anesthesia and non-invasive monitorization, types of sedoanalgesia and antagonism or post-procedural complications (Table 3).

Practice of Pediatric Anesthesia Outside the Operating Room According to Hospital Type: State hospitals were associated with less frequent implementation of pediatric anesthesia outside the operating room with an on-demand or rarely practice rate of 62.5% compared with the corresponding rates of 19.5%, 37.5% and 20.8% in training-research, private and university hospitals, respectively (p<0.01 for each) (Table 4).
Table 3. Practices and resources for pediatric anesthesia outside the operating room according to professional title of physicians

| Pediatric anesthesia outside the operating room | Professional title |
|-------------------------------------------------|--------------------|
|                                                  | Resident (n=45)     | Associate Professor (n=16) | Professor (n=13) | Specialist without academic position (n=89) | p value |
| Frequency per week                               |                    |                        |                   |                                          |         |
| Couple of days                                   | 29 (65.9)^a        | 7 (43.8)               | 4 (33.3)          | 36 (40.4)                                 | 0.001^1 |
| Every day                                        | 2 (4.5)            | 6 (37.5)^*             | 8 (66.7)^*        | 28 (31.5)^*                               |         |
| On demand                                        | 10 (22.7)          | 2 (12.5)               | 0 (0.0)           | 19 (21.3)                                 |         |
| Rarely                                           | 3 (6.8)            | 1 (6.3)                | 0 (0.0)           | 6 (6.7)                                   |         |
| ASA criteria for candidacy                       |                    |                        |                   |                                          |         |
| None                                             | 17 (37.8)          | 7 (43.8)               | 7 (53.8)          | 34 (38.2)                                 | 0.772^1 |
| ASA I                                            | 19 (42.2)          | 4 (25.0)               | 4 (30.8)          | 37 (41.6)                                 |         |
| ASA I-II                                         | 6 (13.3)           | 5 (31.3)               | 2 (15.4)          | 15 (16.9)                                 |         |
| ASA I-III                                        | 3 (6.7)            | 0 (0.0)                | 0 (0.0)           | 3 (3.4)                                   |         |
| Age criteria for candidacy                       |                    |                        |                   |                                          |         |
| None                                             | 33 (73.3)          | 12 (75.0)              | 11 (84.6)         | 65 (73.0)                                 | 0.970^1 |

| Method for anesthesia                            |                    |                        |                   |                                          |         |
| General anesthesia                               | 12 (16.2)          | 7 (25.0)               | 7 (26.9)          | 35 (22.9)                                 | 0.851^2 |
| Deep sedation                                    | 35 (47.3)          | 12 (42.9)              | 12 (46.2)         | 73 (47.7)                                 |         |
| Conscious sedation                               | 27 (36.5)          | 9 (32.1)               | 7 (26.9)          | 45 (29.4)                                 |         |

| Use of regional anesthesia                       |                    |                        |                   |                                          |         |
| Yes                                              | 3 (6.7)            | 4 (25.0)^*             | 4 (30.8)^*        | 5 (5.6)                                   | 0.008^1 |
| No                                               | 42 (93.3)          | 12 (75.0)              | 9 (69.2)          | 84 (94.4)                                 |         |

| Method for non-invasive monitoring               |                    |                        |                   |                                          |         |
| ECG                                              | 37 (30.3)          | 15 (30.6)              | 11 (28.2)         | 73 (28.7)                                 | 0.166^1 |
| Pulse oximetry                                   | 45 (36.9)          | 16 (32.7)              | 13 (33.3)         | 88 (34.6)                                 |         |

| Hypnotic agents used for sedoanalgesia           |                    |                        |                   |                                          |         |
| Midazolam                                        | 43 (32.6)          | 15 (28.8)              | 13 (34.2)         | 83 (31.6)                                 | 0.958^1 |
| Propofol                                         | 40 (30.3)          | 15 (28.8)              | 11 (28.9)         | 74 (28.1)                                 |         |
| Ketamine                                         | 41 (31.1)          | 16 (30.8)              | 10 (26.3)         | 79 (30.0)                                 |         |
| Etomidate                                        | 1 (0.8)            | 0 (0.0)                | 0 (0.0)           | 1 (0.4)                                   |         |
| Thiopental                                       | 7 (5.3)            | 6 (11.5)               | 4 (10.5)          | 26 (9.9)                                  |         |

| Use of antagonism                                |                    |                        |                   |                                          |         |
| Always                                           | 3 (6.7)            | 2 (12.5)               | 0 (0.0)           | 7 (8.0)                                   | 0.186^1 |
| Sometimes                                        | 29 (64.4)          | 12 (75.0)              | 10 (76.9)         | 44 (50.6)                                 |         |
| Never                                            | 13 (28.9)          | 2 (12.5)               | 3 (23.1)          | 36 (41.4)                                 |         |

| Place of recovery                                |                    |                        |                   |                                          |         |
| Waiting room                                     | 4 (8.9)            | 0 (0.0)                | 1 (7.7)           | 7 (7.9)                                   | 0.002^1 |
| Recovery room                                    | 9 (20.0)           | 8 (50.0)^*             | 5 (38.5)          | 51 (57.3)^*                               |         |

| Post-procedural complications                    |                    |                        |                   |                                          |         |
| Desaturation                                     | 44 (51.8)          | 15 (55.6)              | 13 (50.0)         | 82 (57.7)                                 | 0.901^1 |
| Hypotension                                      | 7 (8.2)            | 1 (3.7)                | 3 (11.5)          | 8 (5.6)                                   |         |
| Brady-arrhythmia                                 | 14 (16.5)          | 5 (18.5)               | 6 (23.1)          | 27 (19.0)                                 |         |
| Nausea/vomiting                                  | 20 (23.5)          | 6 (22.2)               | 4 (15.4)          | 25 (17.6)                                 |         |

^1Fisher Freeman Halton test (Monte Carlo), ^2Pearson Chi-Square Test (Monte Carlo); Post Hoc Test: Benjamini-Hochberg correction

*p<0.01 compared to resident physicians, ^p<0.01 compared to specialists

A recovery room was more commonly used for recovery in state (62.5%), training-research (61.0%) and private (62.5%) hospitals than in university hospitals (33.7%) (p<0.01 for each), while use of the
same room for both anesthesia and recovery was more common in university hospitals (58.2%) compared with state (31.3%), training-research (24.4%) and private (0.0%) hospitals (p<0.01 for each). The use of hospital wards for recovery was more common in private hospitals (25.0%) than in training-research (2.4%) and university (2.0%) hospitals (p<0.01 for each) (Table 4).

No significant difference was noted between hospital types in the practice of pediatric anesthesia outside the operating room in respect of the use of candidacy criteria, the room for the procedure, methods for anesthesia and non-invasive monitorization, use of regional anesthesia, types of sedoanalgesia and antagonism or post-procedural complications (Table 4).

Discussion

This questionnaire-based survey revealed frequent application of pediatric anesthesia outside the operating room by most of the participating physicians, ranging from a couple of days per week to every day and mostly for MRI, endoscopy, pediatric angiography and biopsy procedures. ASA physical status rather than the age of patient was considered more commonly by physicians in the selection of appropriate candidates. Desaturation was reported to be the most commonly noted post-procedural adverse event, while only 4 physicians had previously experienced the death of a patient related to the procedure.

Accordingly, the findings of this study seem consistent with the frequent use of pediatric anesthesia outside the operating room in invasive medical procedures, such as imaging diagnostics, invasive radiology, cardiac catheterization and endoscopies (7) with a well-described overall low adverse event rate involving persistent desaturation in most cases for a variety of procedures in certain settings (8). In fact, the association of age <1 year or 5 years and ASA status III or IV with failed sedation and an increased risk of adverse events has consistently been reported in the literature (2,3,8-12). Therefore, the consideration of ASA physical status I-II by only 39.3% and patient age by only 25.0% of physicians in the present cohort seems notable.

The most commonly preferred method for anesthesia was deep sedation (81.0%), while pulse oximetry (99.4%) and ECG (83.4%) were the most commonly preferred methods for non-invasive monitorization with the use of end-tidal carbon dioxide by 33.1% of physicians in this cohort. This seems notable as pulse oximetry is not considered to be sufficient to detect the respiratory complications of sedation, and it is recommended that close clinical monitoring of the breathing pattern of the patient is applied with the use of end-tidal carbon dioxide for the detection of such complications and for the early detection of airway obstruction (11).

In the current study, midazolam (94.5%), propofol (85.9%) and ketamine (89.6%) were reported to be the most common hypnotic agents used for sedoanalgesia, which seems to be consistent with agents recommended for non-pain procedures (i.e. MRI; propofol, chloral hydrate, diazepam, midazolam, methohexital, pentobarbital and etomidate) with the addition of non-opiate analgesics such as ketamine or opiates analgesics to the treatment regimen for painful procedures (i.e. bone marrow biopsy, reduction of fractures, burn scrubs) (13,14). Nonetheless, while propofol or ketamine with the co-administration of benzodiazepines (principally midazolam) are the most commonly used agents for pediatric anesthesia outside the operating room, the clear benefit of these combinations on pain reduction or amelioration of recovery agitation as well as their impact on the developing brain remains controversial (2,4,7,12,15-22). This also seems notable given the recently reported trend of using more potent sedatives and hypnotics by non-anesthesiologists (i.e. physicians and nurses) (13,23,24).

Anesthesia technicians and anesthesia specialists were identified as the primary members of the team, while hospital conditions were considered to be appropriate by 77.6% of the physicians and the room for procedure was considered sufficiently large by 54.0%. Available on-site equipment included an oxygen source pulse oximetry, aspirator, emergency care bag, monitor and crash cart in the majority of cases, while an equipment check-list was reported to be available before the procedure by only 57.7% of physicians. Several guidelines are available on the provision of services for anesthetic care outside the operating room including USA Centers for Medicare and Medicaid Services (CMS) directives (25), UK Royal College of Anesthetists guidelines (26), the National Institute for Clinical Excellence (NICE) Clinical Guidelines (27) and American Academy of Pediatrics (AAP) guidelines in collaboration with the American Academy of Pediatric Dentistry (AAPD) and the American Society of Anesthesiologists (ASA) (28,29).

A summary of their recommendations includes delivery of anesthesia services by appropriately trained healthcare providers and in accordance with recognized standards for anesthesia care including informed consent, appropriate fasting intervals, infection control, safety practices, availability of age and size appropriate equipment, the use of physiological monitoring, the need for basic life
**Table 4.** Practices and resources for pediatric anesthesia outside the operating room according to hospital type

| Pediatric anesthesia outside the operating room | Hospital type |
|-----------------------------------------------|---------------|
|                                               | State hospital (n=16) | Training-research hospital (n=41) | Private hospital (n=8) | University hospital (n=98) | p value |
| Frequency per week                           |                |                                |                        |                         |         |
| Couple of days                               | 3 (18.8)       | 19 (46.3)                      | 2 (25.0)               | 52 (54.2)                | 0.009   |
| Every day                                    | 3 (18.8)       | 14 (34.1)                      | 3 (37.5)               | 24 (25.0)                |         |
| On demand                                    | 6 (37.5)       | 5 (12.2)*                      | 3 (37.5)               | 17 (17.7)                |         |
| Rarely                                       | 4 (25.0)       | 3 (7.3)                        | 0 (0.0)*               | 3 (3.1)*                 |         |
| ASA criteria for candidacy                   |                |                                |                        |                         |         |
| None                                         | 6 (37.5)       | 15 (36.6)                      | 1 (12.5)               | 43 (43.9)                | 0.281   |
| ASA I-II                                     | 8 (50.0)       | 14 (34.1)                      | 5 (62.5)               | 37 (37.8)                |         |
| ASA I-III                                    | 1 (6.3)        | 11 (26.8)                      | 1 (12.5)               | 15 (15.3)                |         |
| ASA I                                        | 1 (6.3)        | 1 (2.4)                        | 1 (12.5)               | 3 (3.1)                  |         |
| Age criteria for candidacy                   |                |                                |                        |                         |         |
| None                                         | 10 (62.5)      | 27 (65.9)                      | 5 (62.5)               | 79 (80.6)                | 0.117   |
| Exclusion of neonatal age group              | 3 (18.8)       | 5 (12.2)                       | 2 (25.0)               | 11 (11.2)                |         |
| Exclusion of <3 years age group              | 3 (18.8)       | 4 (9.8)                        | 1 (12.5)               | 5 (5.1)                  |         |
| Exclusion of infantile age group             | 0 (0.0)        | 5 (12.2)                       | 0 (0.0)                | 3 (3.1)                  |         |
| The room for procedure                       |                |                                |                        |                         |         |
| Sufficiently large                          | 7 (28.0)       | 25 (34.2)                      | 7 (36.8)               | 49 (30.2)                | 0.869   |
| Has crash cart                               | 14 (56.0)      | 31 (42.5)                      | 7 (36.8)               | 79 (48.8)                |         |
| Safe                                         | 4 (16.0)       | 17 (23.3)                      | 5 (26.3)               | 34 (21.0)                |         |
| Method for anesthesia                        |                |                                |                        |                         |         |
| General anesthesia                           | 1 (4.2)        | 17 (25.0)                      | 3 (23.1)               | 40 (22.7)                | 0.237   |
| Deep sedation                                | 11 (45.8)      | 33 (48.5)                      | 7 (53.8)               | 81 (46.0)                |         |
| Conscious sedation                           | 12 (50.0)      | 18 (26.5)                      | 3 (23.1)               | 55 (31.3)                |         |
| Use of regional anesthesia                   |                |                                |                        |                         |         |
| Yes                                          | 0 (0.0)        | 2 (4.9)                        | 0 (0.0)                | 14 (14.3)                | 0.172   |
| No                                           | 16 (100.0)     | 39 (95.1)                      | 8 (100.0)              | 84 (85.7)                |         |
| Method for non-invasive monitoring           |                |                                |                        |                         |         |
| ECG                                          | 13 (34.2)      | 35 (27.6)                      | 4 (21.1)               | 84 (30.0)                |         |
| Pulse oximetry                               | 15 (39.5)      | 41 (32.3)                      | 8 (42.1)               | 98 (35.0)                |         |
| Non-invasive blood pressure                  | 7 (18.4)       | 26 (20.5)                      | 3 (15.8)               | 65 (23.2)                | 0.627   |
| ET CO2                                       | 3 (7.9)        | 22 (17.3)                      | 3 (15.8)               | 26 (9.3)                 |         |
| Heat monitoring                              | 0 (0.0)        | 3 (2.4)                        | 1 (5.3)                | 7 (2.5)                  |         |
| Hypnotic agents used for sedoanalgia         |                |                                |                        |                         |         |
| Midazolam                                    | 16 (33.3)      | 40 (32.3)                      | 6 (27.3)               | 92 (31.6)                | 0.987   |
| Propofol                                     | 13 (27.1)      | 36 (29.0)                      | 6 (27.3)               | 85 (29.2)                |         |
| Ketamine                                     | 15 (31.3)      | 37 (29.8)                      | 6 (27.3)               | 88 (30.2)                |         |
| Etomidate                                    | 0 (0.0)        | 0 (0.0)                        | 0 (0.0)                | 2 (0.7)                  |         |
| Thiopental                                   | 4 (8.3)        | 11 (8.9)                       | 4 (18.2)               | 24 (8.2)                 |         |
| Use of antagonist                            |                |                                |                        |                         |         |
| Always                                       | 1 (6.7)        | 4 (9.8)                        | 0 (0.0)                | 7 (7.2)                  | 0.545   |
| Sometimes                                    | 6 (40.0)       | 24 (58.5)                      | 4 (50.0)               | 61 (62.9)                |         |
| Never                                        | 8 (53.3)       | 13 (31.7)                      | 4 (50.0)               | 29 (29.9)                |         |
| Place of recovery                            |                |                                |                        |                         | <0.00   |
| Recovery room                                | 10 (62.5)*     | 25 (61.0)*                     | 5 (62.5)*              | 33 (33.7)                | 1       |
| Ward                                         | 1 (6.3)        | 1 (2.4)                        | 2 (25.0)*              | 2 (2.0)                  |         |
| The same room as procedure                   | 5 (31.3)*      | 10 (24.4)*                     | 0 (0.0)*               | 57 (58.2)                |         |
| Post-procedural complications                |                |                                |                        |                         |         |
| Desaturation                                 | 14 (66.7)      | 40 (58.0)                      | 6 (75.0)               | 94 (51.6)                | 0.410   |
| Hypotension                                  | 0 (0.0)        | 2 (2.9)                        | 1 (12.5)               | 16 (8.8)                 |         |
| Brady-arrhythmia                             | 2 (9.5)        | 15 (21.7)                      | 1 (12.5)               | 34 (18.7)                |         |
| Nausea/vomiting                              | 5 (23.8)       | 12 (17.4)                      | 0 (0.0)                | 38 (20.9)                |         |

Fisher Freeman Halton test (Monte Carlo); Post Hoc Test: Benjamini-Hochberg correction

* p<0.01 compared to state hospital, ** p<0.01 compared to university hospital and * p<0.01 compared to training and research hospital
support skills, access to resuscitation and monitoring equipment (particularly for children assessed as an ASA 3 or higher grade and/or the under 1 year of age) and proper recovery/discharge procedures and (6,25-29).

The findings of the current study indicate that the practice of pediatric anesthesia outside the operating room as stated by the participating physicians is in accordance with the standards for anesthesia care recommended in these guidelines in terms of members of the anesthesia team, informed consent, appropriate fasting intervals, available equipment and access to resuscitation and monitoring equipment. Likewise, data from a large prospective survey examining pediatric sedation/anesthesia in a tertiary academic hospital revealed that a dedicated sedation team using a written protocol provided a service with minimal case cancellation, no sedation failure, favorable safety, and excellent parental satisfaction (11).

Notably, the professors were determined to be the group with the highest rates for the procedure on a daily basis and use of regional anesthesia was more common among faculty members, while state hospitals were associated with less frequent implementation of pediatric anesthesia outside the operating room compared with training-research, private and university hospitals. This seems notable given the consideration of the exemplary training and education of individuals involved in sedating children along with developing and maintaining robust systems for them to work within as the key to providing safe and effective pediatric sedation (6).

Professional title or hospital type had no significant impact on the practice of pediatric anesthesia outside the operating room in terms of candidacy criteria, methods for anesthesia and non-invasive monitoring, types of sedoanalgesia and antagonism or post-procedural complications. However, the place of recovery was more commonly the recovery room in hospitals other than university hospitals, was the same room in which the anesthesia procedure had been applied in university hospitals and was the hospital ward in private hospitals.

The current study findings also indicate a need for improved practice regarding consideration of appropriate candidacy for ASA physical status and patient age as well as a uniform and standardized recovery practice among anesthesia specialists. Currently, most of the available sedation guidelines consider specific specialties with a lack of uniform sedation guidelines and conformity and agreement between specialists on recommendations and practice (30). Hence, a need for large scale multi-specialist delivered sedation studies has been emphasized to be able to provide specific sedation-related outcomes to support the design of evidence-based guidelines (30).

Certain limitations to this study should be considered. First, the cross-sectional nature of the study precludes the possibility of drawing extensive causal conclusions. Second, the relatively small sample size reduces the generalizability of the findings, necessitating a need for continued investigations in this area. Third, collection of data based on an online questionnaire form rather than direct observation of practice seems to be another limitation which otherwise would extend the knowledge achieved in the current study.

In conclusion, this questionnaire-based survey revealed frequent application of pediatric anesthesia outside the operating room by anesthesiology and reanimation specialists and adherence to recommended guidelines with similar scope of practice and resource allocations for the procedure between different hospital types. Alongside the likelihood of professional training and hospital type to influence frequency of the procedure and recovery strategies, these findings emphasize a need for improved practice regarding consideration of appropriate candidacy for ASA physical status and patient age as well as a uniform and standardized recovery practice among anesthesiology and reanimation specialists. Large prospective outcome studies on sedation practice with a collaborative effort of all sedation providers are necessary to determine optimal sedation practices within and between specialties.

**Funding: None**

**Conflict of interest:** The authors declare that they have no conflict of interests

**References**

1. Connor MP, Dion GR, Borgman M, Maturo S. The pediatric sedation unit: a prospective analysis of parental satisfaction. Int J Pediatr Otorhinolaryngol 2014; 78: 2165-2168.
2. Grunwell JR, Travers C, McCracken CE, et al. Procedural Sedation Outside of the Operating Room Using Ketamine in 22,645 Children: A Report From the Pediatric Sedation Research Consortium. Pediatr Crit Care Med 2016; 17: 1109-1116.
3. Malviya S, Voepel-Lewis T, Eklevik OP, Rockwell DT, Wong JH, Tait AR. Sedation and general anaesthesia in children undergoing MRI and CT: adverse events and outcomes. Br J Anaesth 2000; 84; 743-748.
4. Akin A, Esmooglu A, Tosun Z, Gulcu N, Aydogan H, Boyaci A. Comparison of propofol

---

East J Med Volume:24, Number:3, July-September/2019

348
with propofol-ketamine combination in pediatric patients undergoing auditory brainstem response testing. Int J Pediatr Otorhinolaryngol 2005; 69: 1541-1545.

5. Landrum AL. Anesthesia for sites outside the operating room. Adv Anest 2006; 24: 163 - 175.

6. Peyton J, Cravero J. Sedation in children outside the operating room: The rules of the road. Trends Anaest Crit Care 2014; 4: 141-146.

7. Burbano-Paredes CC, Amaya-Guio J, Rubiano-Pinzón AM, Hernández-Caicedo AC, Grillo-Ardila CF. Guía práctica clínica para la administración de sedación fuera del quirófano en pacientes mayores de 12 años. Rev Colomb Anestesiol 2017; 45: 224-238.

8. Biber JL, Allareddy V, Allareddy V, et al. Prevalence and Predictors of Adverse Events during procedural sedation anesthesia/outside the operating room for esophagogastroduodenoscopy and colonoscopy in children: Age is an independent predictor of outcomes. Pediatr Crit Care Med 2015; 16: 251-259.

9. Green SM, Rothrock SG, Lynch EL, et al. Intramuscular ketamine for pediatric sedation in the emergency department: Safety profile in 1,022 cases. Ann Emerg Med 1998; 31: 688-697.

10. Vade A, Sukhani R, Dolenga M, Habisohn-Schuck C. Chlortal hydrate sedation of children undergoing CT and MRI imaging: safety as judged by American Academy of Pediatrics guidelines. Am J Roentgenol 1995; 165: 905-909.

11. Gozal D, Drenger B, Levin PD, Kadari A, Gozal Y. A pediatric sedation/anesthesia program with dedicated care by anesthesiologists and nurses for procedures outside the operating room. J Pediatr 2004; 145: 47-52.

12. Green SM, Roback MG, Krauss B, et al. Emergency Department Ketamine Meta-Analysis Study Group. Predictors of airway and respiratory adverse events with ketamine sedation in the emergency department: An individual-patient data meta-analysis of 8,282 children. Ann Emerg Med 2009; 54: 158-168.

13. Szmuk P, Steiner JW, Sheeran PW, et al. Sedation and anesthesia for magnetic resonance imaging in pediatric patients: is dexmedetomidine the answer? Sem Anesth Periop Med Pain 2007; 26: 229-236.

14. Cravero JP, Blike GT, Beach M, et al. Incidence and nature of adverse events during pediatric sedation/anesthesia for procedures outside the operating room: report from the Pediatric Sedation Research Consortium. Pediatrics 2006; 118: 1087-1096.

15. Green SM, Roback MG, Kennedy RM, et al. Clinical practice guideline for emergency department ketamine dissociative sedation: 2011 update. Ann Emerg Med 2011; 57: 449-461.

16. Kennedy RM, McAllister JD. Midazolam with ketamine: Who benefits? Ann Emerg Med 2000; 35: 297-299.

17. Roback MG, Warthen JE, Bajaj L, et al. Adverse events associated with procedural sedation and analgesia in a pediatric emergency department: A comparison of common parenteral drugs. Acad Emerg Med 2005; 12: 508-513.

18. Kamat PP, McCracken CE, Gillespie SE, et al. Pediatric critical care physician-administered procedural sedation using propofol: a report from the Pediatric Sedation Research Consortium Database. Pediatr Crit Care Med 2015; 16: 11-20.

19. Kamat PP, Kudchadkar SR, Simon HK. Sedative and Anesthetic Neurotoxicity in Infants and Young Children: Not Just an Operating Room Concern. J Pediatr 2019; 204: 285-290.

20. Litman RS. Sedation and anesthesia outside the operating room: answers to common questions. Semin Pediatr Surg 1999; 8: 34-39.

21. Akhondzadeh R, Ghomeishi A, Nesioonpour S, Nourizade S. A comparison between the effects of propofol-fentanyl with propofol-ketamine for sedation in patients undergoing endoscopic retrograde cholangiopancreatography outside the operating room. Biomed J 2016; 39: 145-149.

22. Sherwin TS, Green SM, Khan A, et al. Does adjunctive midazolam reduce recovery agitation after ketamine sedation for pediatric procedures? A randomized, double-blind, placebo-controlled trial. Ann Emerg Med 2000; 35: 229-238.

23. Barbi E, Gerarduzzi T, Marchetti F, et al. Deep sedation with propofol by nonanesthetists: a prospective pediatric experience. Arch Pediatr Adolesc Med 2003; 157: 1097-1103.

24. Cravero JP, Blike GT. Review of pediatric sedation. Anesth Analg 2004; 99: 1355-1364.

25. CMS.CMS guidelines on provision of anesthesia services; 2010. http://www.cms.gov/Regulations-and-Guidance/Guidance/Transmittals/downloads/R59OSMA.pdf.

26. RCOA guidelines for the provision of anesthesia services for care in the non-theatre environment; 2013.

27. NICE. NICE clinical guideline 112. Sedation in children and young people. NICE; 2010. http://www.nice.org.uk/nicemedia/live/13296/52130/52130.pdf.

28. Guidelines for the elective use of conscious sedation, deep sedation, and general anesthesia in pediatric patients. Committee on Drugs Section on Anesthesiology, Pediatrics 1985; 76: 317-321.

29. The Joint Commission. Sedation and anesthesia care standards; 2003.

30. Mason KP. Challenges in paediatric procedural sedation: political, economic, and clinical aspects British J Anaesth 2014; 113: 48-62.