

Avoidance of deep anesthesia and artificial airways in 1000 neonates and infants using regional anesthesia: A retrospective observational analysis

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Abstract

Background and Aims: Current concerns related to the anesthetic neurotoxicity have brought a renewed interest in regional anesthesia. Regional anesthesia reduces the need for opioids and inhalational anesthetics. The immaturity of the neonatal and infant nervous system may render them more prone to neurotoxicity. We describe our technique of anesthesia, which minimizes the exposure to general anesthetics and reduces airway instrumentation because the operability is rendered by the regional block.

Material and Methods: This was a retrospective case series of neonates and infants undergoing common surface surgeries. We describe our technique of anesthesia where regional blocks are the mainstay. We also put up the data pertaining to block effectiveness, technique, end-tidal sevoflurane concentration and complications.

Results: One thousand patients, including neonates and infants, received central and peripheral nerve blockade. The failure rate in upper extremity blocks 0% without complications. 86.12% were given under ultrasonography (USG) guidance and 13.89% were given with peripheral nerve stimulation. The failure rate of sciatic block single shot and continuous was 0%. 92.53% were given with USG guidance while 7.46% received sciatic with nerve stimulation technique. Failure rate of caudal epidural block was 0.78% requiring a rescue analgesic, 1.4% had blood in the needle. Out of the caudals, 33.33% were done with USG guidance and 66.67% blocks were given with traditional techniques. Out of the 322 penile + ring blocks given by traditional method, 1 block failed requiring rescue analgesics. The mean sevoflurane concentration was 1.2 +/- 0.32.

Conclusion: It is feasible to conduct surface surgeries in the most vulnerable population such as neonates and infants under regional anesthesia without intubation and airway instrumentation.

Keywords: Infants, neonates, regional anesthesia

Introduction

Neonates and infants are a vulnerable population to undergo anesthesia and surgery due to their immature organ systems. The cardiovascular, central nervous and respiratory systems in neonates and infants are more sensitive to the depressant

effects of anesthetic drugs.^[1] The use of regional anesthesia in conjunction with general anesthesia would allow for a significant reduction in the requirements for volatile anesthetic agents and decrease the total dose of intravenous anesthetic agents while maintaining surgical anesthesia. Although the major impetus for such trials and strategies has been to provide effective analgesia, while limiting the need for systemic opioids as a means of achieving early tracheal extubation, this approach

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could become a favorable alternative to the traditional general anesthetic technique with the goal of reducing the overall exposure to potentially neurotoxic agents in neonates and also airway instrumentation.^[2] The popularity of regional anesthesia is caused by its impact on pain management without changing the physiological milieu to a great extent. While regional anesthesia in infants and neonates may carry a slightly increased risk of complications,^[1] its use and safety is well established in children.^[3,4] However, it is often used in combination with general anesthesia or heavy sedation.^[5]

We describe our technique of anesthesia where in regional anesthesia is used as the mainstay of the anesthesia plan. We report minimized exposure to general anesthetics and exclude endotracheal intubation or any kind of airway instrumentation such as endotracheal intubation and supraglottic airway devices, muscle relaxants, opioids in neonates and infants.

The aim is to describe our technique of anesthesia, which minimizes the exposure to general anaesthetics and prevents intubation or any airway instrumentation because the operability is rendered by the regional block.

Material and Methods

The study population consisted of 1000 consecutive neonates and infants posted for superficial pediatric surgeries and orthopedic procedures performed from 1st May 2015 to 1st May 2016. After obtaining approval from the IRB the data forms recorded by the attending anesthesiologist, recorded complications, events, average end-tidal concentration of sevoflurane and records of routine post-operative visits until 4 hours of surgeries were obtained and analyzed retrospectively.

Neonates and infants undergoing sub-umbilical surgery, lower limb and upper limb surgeries were included. The exclusion criteria were cavity-invading surgeries such as laparotomies, thoracotomies, laparoscopic procedures that required intubation and bleeding disorders.

The demographics for neonates and infants are shown in Table 1. Tables 2 and 3 show demographics of neonates and infants and the types of surgeries conducted respectively.

Neonates and infants were fasted as per the standard fasting guidelines.

All patients without IV access were induced with sevoflurane in oxygen and air mixture, followed by venous cannulation. Patients with IV access were induced with Propofol 2-3 mg/kg IV.

All patients were maintained on spontaneous respiration with 50% oxygen in air and inhalational agent via facemask and Jackson Rees circuit. We calculated mean end-tidal Sevoflurane, reflecting the average end-tidal sevoflurane concentration at any given point in the case.

The facemask was harnessed with a cotton cloth surgical mask in all patients [Figure 1].^[6]

In all cases, standard monitoring was implemented. The drug dosages and volumes of local anesthetic used were dependent on the block chosen and its indication [Table 4]. Depending on availability of equipment caudal epidural blocks was given with landmark techniques or under ultrasound guidance.^[5,7] Penile blocks were combined with ring blocks and were given with traditional approach. Infraclavicular brachial plexus blocks were given with ultrasound guidance.^[8] Peripheral nerve stimulation was used if ultrasound machine was not available for single shot infraclavicular blocks.^[9] Sciatic nerve blocks, single shot as well as continuous blocks, were chosen for unilateral lower extremity.^[10] The continuous blocks were done under ultrasound guidance with epidural catheter sets.^[11,12]

Diclofenac suppositories 1 mg/kg were given to infants and paracetamol 15 mg/kg suppositories were used in neonates every 8 hours.

Table 1: Demographics of neonates and infants included in the study

Demographic data	Neonates	Infants
Age (Days)		
Mean±SD	12.5±0.15	9.4±0.2
Mean weight (kilograms)		
Mean±SD	2.7±0.12	9.1±0.4
Male	79	576
Female	16	329



Figure 1: Face mask used as harness

Table 2: Types of surgeries and their respective numbers in neonates

Surgery	Herniotomy	Circumcision	Lower extremity Surgeries	Upper extremity	Vesicostomy	P U Valve fulguration	Anoplasty
No of Patients	40	42	1	1	2	5	4

Table 3: Types of surgeries and their respective numbers in infants

Surgery	Herniotomy	Circumcision	HPS	Orchiopexy	Lower extremity Surgeries	Upper extremity
No of Patients	289	280	79	155	67	35

Table 4: Types of surgeries, block chosen and respective volume of local anesthetic

Type of Surgery	Volume of Drug used	Type of Block
Herniotomy, Orchiopexy, Umbilical granuloma, Umbilical hernia.	1 ml/kg (0.25% Bupivacaine)	Caudal epidural
Hypospadias repair, meatoplasty, clitoroplasty, torsion testis, rectal biopsy, anoplasty, fistulectomy, Posterior Urethral valve, fulguration, testicular tumour, anal tag excision, scrotal explorations amniotic band excision	0.5 ml/kg (0.25% Bupivacaine)	Caudal epidural
Circumcision	0.3 ml/kg (0.25% Bupivacaine)	Penile + ring
Upper limb surgeries	0.5 ml/kg (0.25% Bupivacaine)	Infraclavicular continuous catheters:
Radial club hand repair, Pollicisation, Supracondylar fracture open fixation		
Lower limb surgery, Bilateral Z plasty	0.5 ml/kg (0.25% Bupivacaine)	Caudal epidural
Tibialosteomyelitis, curettage		
Femoral osteomyelitis		
Thigh abscess		
Knee arthrotomy		
Postero medial release + Botox injection		
Bilateral ctev 1 (talipoequinovarus)		
Bilateral Amniotic band excision		
Fibular bone grafting, Tibial nailing	0.5 ml/kg (0.25% Bupivacaine)	Continuous sciatic perineural catheter.
Jess fixation. 1		
Unilateral Congenital taliequinovarus correction		
Hip arthrogram with spika	1 ml/kg (0.25% Bupivacaine)	Caudal epidural
Adductor tenotomy		
Contused Lacerated wound	0.5 ml/kg (0.25% Bupivacaine)	Local infiltration
Nail bed suturing	0.5 ml/kg (0.25% Bupivacaine)	Axillary brachial plexus block

The reported block failures (Failure was defined as 20% rise in heart rate after surgical stimulus), rescue analgesics, regional anesthesia complications, airway related complications and the average reported concentration of inhalational agents were noted.

Results

The data were analysed using SPSS software. The average age in months, weight in kilograms, end-tidal concentration of sevoflurane as mean ± SD.

1000 total case. These included 905 infants and 95 neonates. The respective demographics and types of surgeries are shown in the [Tables 1-4]. 896 cases were done under caudal block.

Upper extremity blocks

Complications and failure rates

The failure rate in upper extremity blocks 0%. 86.12% were given under ultrasound guidance and 13.89% were given with peripheral nerve stimulation. There were no block failures.

Lower extremity blocks

Complications and failure rates

The failure rate of sciatic block single shot and continuous was 0%. 92.53% were given with ultrasound guidance while 7.46% received sciatic with nerve stimulation technique.

Caudal epidural blocks

Complications and failure rates

In 12 of 896 (1.4%) cases, blood in the needle was recorded. 4 cases (33.33%) of these were done with USG guidance, 8 (66.67%) blocks were given with traditional techniques. On each occasion, the needle was removed and replaced with a new needle. The procedure was repeated. None of these blocks with this issue failed.

In one case, age 32 days, for bilateral hernia, the neonate was noted apneic after turning to supine position. Required ventilation for few minutes recovered and the surgery continued uneventfully.

Block Failures: 7 of 896 (0.78%) patients required rescue analgesia after surgical incision.

Penile + Ring block: Out of the total given, there was 1 block failure. Rescue analgesic was given.

Airway complications: Incidence of laryngospasm (0.7%). Out of 7, 2 cases had laryngospasm twice during the procedure.

No cases required conversion to general anesthesia with endotracheal intubation or insertion of airway device.

Post-operative pain score: 99% had sufficient pain relief in the immediate post-operative period as per the NIPS (neonatal infant pain scale).

The mean sevoflurane concentration was 1.2 +/- 0.32

Discussion

Our main contention is to state that regional anesthesia reduces the need for deep general anesthesia and avoids intubations, muscle relaxants or any airway instrumentation in neonates and infants for superficial surgeries listed in the tables.

Our rationale being:

1. Airway manipulation requires a greater depth of anesthesia and correspondingly higher dosages of anaesthetic agents, which should be ideally avoided
2. Once the regional block is in place the operability is rendered by the block and lighter planes of anesthesia suite well [Videos 1 and 2].

Although the concern of neurotoxicity may not be entirely established in human infants,^[13] it does remain a concern in this population. Until conclusive data is available, we should try and reduce the exposure to inhalational agents and opioids. The exposure may not be eliminated but regional anesthesia can be used as the primary form of anesthesia rather than as a supplement to general anesthesia. The general anesthesia sparing effect of regional anesthesia at its best, stands intuitive, quantification as such seems difficult because the BIS monitoring itself is unreliable in neonates and infants. The inhalational agent in our case series was fine-tuned enough to maintain sedation or immobility there by maintaining an absolutely natural airway, a sign in itself of not very deep anesthesia. Secondly the mean sevoflurane concentration demonstrated in our study is 1.2 +/- 0.32 (50% O₂-50% Air). The sevoflurane concentration of approximately 1.5-2% in combination with a mixture of oxygen and nitrous oxide (50% O₂-50% N₂O) is accepted as sedation,^[14] which is greater than the average concentration we have used. Although it has been documented that the average sevoflurane end-tidal concentration of 1.2% corresponded for a BIS = 50 (95% confidence interval) in children, it was 1.55% (1.40-1.70)

for infants for the same BIS value,^[15] we do understand that the BIS may not have clear implication in this age group.

Through practical experience, we can state that once the regional block “sets in”, we do not require the same dial settings of the inhalational agents that we would have otherwise required, for the block needle insertion or for venous cannulations. None of our patients required to be given traditional general anesthesia with endotracheal intubation.

The failure rates of 1.4% (7 of 893) of the caudal epidural were observed. The most common reason being, inadequate time interval between administration of the block and surgical stimulus. Fentanyl 1 to 2 micrograms per kg was administered. Out of 7, one was orchiopexy and 6 were hernia repairs. Interestingly, time lapse is never an issue in orthopaedic procedures for us. The preparation time allows sufficient duration for block action to take up.

Incidence of laryngospasm was 0.7%, which was seen mostly during induction of anesthesia. One case had laryngospasm after surgical stimulus, which could be related to the light plain of anesthesia and inadequate regional block action. This was treated with suxamethonium 0.5 mg/kg IV. These cases did not require airway instrumentation.

One penile block case has an increase in heart rate after surgical stimulation, this settled after 1 mcg/kg of fentanyl. In the post-operative period, this patient was advised a diclofenac suppository as usual protocol. The upper extremity and lower extremity blocks had no failure and no complications.

Morhofer *et al.*^[5] had suggested use of awake caudal and epidurals in every day clinical practice. We suggest from our experience that this could be adapted for upper extremity surgeries in infants as well. Unilateral lower extremity surgeries such as Congenital talipes equines varus (CTEV) corrections in infants were accomplished with continuous sciatic nerve blocks. These surgeries are of relatively longer duration. We use continuous catheters as a routine after a single shot initial bolus^[12] for these surgeries. Analgesia is continued in the post-operative period for 48 hours. The authors^[5] have stated that this should become a standard practice especially with the current thoughts that general anesthetics could be neurotoxic.

The main prerequisite for this technique is the expertise in regional anesthesia in this age group. Our standard practice has evolved though many years of experience in regional anesthesia. The maintenance of natural airway with a mask harnessed with a cotton facemask has added to our ease. The anesthesiologist's hands were free for either securing a vein or for a block procedure [Video 1].

More often regional anesthesia is synonyms with intraoperative and initial postoperative analgesia through this article we have emphasized its role as the sole anesthetic agent with minimal sedation.

Conclusion

It is feasible to conduct surface surgeries and orthopaedic procedures in vulnerable population such as neonates and infants exclusively under regional anesthesia without any airway instrumentation.

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Conflicts of interest

There are no conflicts of interest.

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