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Regional anesthesia alone for pediatric free flaps

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Summary Microvascular surgery plays an important reconstructive role in the pediatric population. Successful outcomes rely on surgical technique as well as anesthesia. Regional anesthesia contributes to successful free tissue transfer through sympathetic blockade, postoperative pain control, and elimination of risks and costs associated with general anesthesia. While regional anesthesia in microsurgery is discussed in the literature for adult and elderly patients, no studies focus on the pediatric population. Accordingly, this paper reviews 20 pediatric patients undergoing microvascular surgery (anterolateral thigh, $n = 9$; gracilis, $n = 3$; toe transfer, $n = 6$; and fibula, $n = 2$) with regional anesthesia and sedation. All patients underwent spinal epidural anesthesia, and seven also received brachial plexus blocks. The average duration of anesthesia was 3—4 h (anterolateral thigh (ALT) and gracilis) and 6—8 h (toe transfer and fibula). No anesthesia-related complications or flap failures occurred. We conclude that regional anesthesia has important benefits in pediatric microsurgery and it is a safe and cost-effective alternative to general anesthesia.

Introduction

In an era of increasing cost and limited resources, the use of regional anesthesia for various surgical procedures has become a cost-effective, safe solution that maximizes surgical outcome and optimizes pain control and patient care.[1] Although generally safe, general anesthesia carries a risk of serious complications, including malignant

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hyperthermia, deep vein thrombosis, pulmonary embolus, and even death.[2] In the pediatric population, airway complications such as laryngospasm are also important considerations with general anesthesia.[3]

Specific to microvascular free tissue transfer, studies suggest benefits of regional anesthesia including increased circulatory blood flow, maintenance of normal body temperature, and diminished systemic stress response.[4,5] Regional blocks and spinal epidural anesthesia provide continuous analgesia and vasodilation, which improves conduit blood flow to the free flap, as well as the microvascular flow distribution within the flap.[5] The use of continuous regional techniques, such as spinal epidural anesthesia, provide important benefits in the postoperative period as well. Reduced vasospasm and incidence of deep vein thrombosis, as well as ongoing analgesia, help with flap success and speed up postoperative recovery.[4,6]

Despite support in the literature for the use of regional anesthesia in microvascular free tissue transfer, regional blocks are typically combined with general anesthesia, subjecting the patient to the associated risks and costs.[4] An exception has been free tissue transfer in patients with medical comorbidities, such as the elderly, where regional anesthesia with sedation has been used successfully.[7] The use of regional anesthesia alone in a series of microvascular free tissue transfers in the pediatric population has yet to be described. The purpose of this study is to retrospectively review our experience with regional anesthesia for microvascular free tissue transfer in pediatric patients to assess its role as a cost-effective, safe alternative to general anesthesia.

Materials and methods

A retrospective review was performed of all pediatric patients (<18 years of age) who underwent microvascular free tissue transfer (anterolateral thigh (ALT), gracilis, toe transfer, and free fibula) at the Ganga Hospital between 2003 and 2014.

Charts were reviewed to determine cases in which regional anesthesia alone was used for the procedure. Operative notes were evaluated to determine characteristics of the defect and free tissue transfer. Patient details including age, sex, comorbidities, and additional injuries were also noted. All surgical- and anesthesia-related complications within the perioperative period (intraoperatively to discharge from hospital) were recorded.

All pediatric microvascular free tissue transfers were performed in a main operating theater with sedation and regional anesthesia by the senior author (SRS). Standard monitoring with noninvasive blood pressure, electrocardiography, body temperature, and peripheral oxygen saturation was performed. Sedation was initially given in the operating theater, with drug doses calculated according to weight. Standard drugs used for initial sedation were glycopyrrolate, midazolam, fentanyl, and ketamine or propofol. Additional doses of ketamine and midazolam were given throughout the procedure as needed to maintain sedation.

Following initial sedation, all patients received spinal epidural anesthesia, as well as a brachial plexus block if the upper extremity was involved. For spinal anesthesia, bupivacaine 0.5% based on body weight was used, while epidural anesthesia consisted of an initial mixture of lidocaine 2% and bupivacaine 0.5%, followed by continuous infusion of bupivacaine. Postoperatively, the spinal epidural was continued with 0.125% bupivacaine and fentanyl 2 mcg/mL at the rate of 3 mL/h for 72 h.

Brachial plexus block (0.5% bupivacaine 2 mg/kg and 2% lidocaine with epinephrine (one in 200,000) 7 mg/kg in 2:1 ratio mixture based on weight) was performed under ultrasound guidance. A subclavian perivascular approach was used if surgery involved the arm below the elbow, while an interscalene approach was used if the upper arm or shoulder was involved.

Postoperatively, the patients were monitored closely for pain control and any perioperative medical or surgical complications. Free flap viability was assessed hourly using clinical examination and handheld Doppler.

Results

Twenty pediatric microvascular free tissue transfers were performed using regional anesthesia and sedation. All 20 patients received spinal epidural anesthesia, while seven patients underwent brachial plexus block for upper-extremity involvement. The average age of the patients was 12.1 years (range 6—17). The types of free tissue transfer consisted of ALT ($n = 9$), gracilis ($n = 3$), toe transfer ($n = 6$), or free fibula ($n = 2$) flaps. The majority of defects were secondary to major crush injuries of the lower extremity. Congenital disorders such as tibial pseudarthrosis and symbrachydactyly were additional etiologies requiring free tissue transfer. Both the youngest and the oldest patients in the series underwent second toe transfers. The details of the patient data are depicted in Table 1.

The average time to perform a brachial plexus block was 3—5 min using ultrasound guidance, while spinal epidural anesthesia took an average of 5 min to perform. The total procedure duration of free tissue transfer was an average 3—4 h (ALT and gracilis) and 6—8 h (fibula and toe transfers).

No anesthetic complications were encountered in any of the cases, either intraoperatively or in the postoperative period prior to discharge. Regarding microvascular flap complications, no reexplorations or flap failures occurred.

Discussion

Regional anesthesia has important benefits in pediatric microvascular free tissue transfer including postoperative pain relief, optimization of patient physiology for microvascular blood flow, safety, and cost savings.[1—3,5]

Postoperative pain is one of the most common anxiety-producing concerns for patients,[1] particularly in the pediatric population. Effective management and relief of postoperative pain are important for humanistic and psychological reasons, and now it is increasingly clear that pain management also plays a vital role in the overall surgical outcome.[8,9] Untreated pain has been linked to prolonged hospital stays, deep venous thrombosis, pulmonary embolus, pneumonia, bowel dysmotility, insomnia, and