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Case Series

Anaesthesia Section

Anaesthetic Challenges in a Paediatric Clubfoot Surgical Camp Held in a Remote Area: A Case Series

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ABSTRACT

Clubfoot, a common birth defect affecting the foot, impacts a significant number of children in low- and middle-income countries. Although many cases of clubfoot can be effectively treated without surgery, some require surgical intervention. Untreated clubfoot can cause severe disabilities, leading to significant social and economic challenges for the affected individuals. Surgical camps provide crucial access to surgical care for underserved populations. This case series examines the anaesthetic management of 10 children who underwent clubfoot surgery during a surgical camp. Providing anaesthesia to children in areas with limited resources presents significant challenges, including undiagnosed medical conditions, malnutrition, restricted access to diagnostic tools, and limited availability of necessary equipment and medications. Nevertheless, spinal anaesthesia was safely administered to these patients, supported by good monitoring and experienced auxiliary staff. This case series suggests that spinal anaesthesia is a safe technique even in remote and resource-limited places in the paediatric age group.

Keywords: Anaesthesia, Outreach, Patient safety, Regional, Resource-limited

INTRODUCTION

Clubfoot, or Congenital Talipes Equino-Varus (CTEV), is one of the most common congenital deformities affecting the lower limbs. The birth prevalence of clubfoot in low- and middle-income settings is estimated to be between 0.5 and 2 per 1,000 births [1]. Given India's population, it is estimated that approximately 27,000 infants are born with clubfoot annually [2]. Surgical correction is often necessary for cases unresponsive to conservative treatments. Anaesthetic management of clubfoot surgery in children demands precise planning to ensure safety, adequate pain control, and smooth recovery. Surgical outreach camps are often organised in regions with limited access to healthcare to provide specialised services at minimal or no cost to patients. However, these camps frequently operate with constrained resources, including a lack of advanced monitoring equipment, a limited drug inventory, and fewer trained personnel.

Limited access to surgical care in remote areas stems not only from infrastructure gaps but also from the healthcare-seeking behaviours of local communities. Many individuals may not fully understand the necessity or potential benefits of treatment [3]. Patient safety is paramount in outreach surgical camps, which often operate in challenging environments with limited resources and support. These conditions can increase the risk of adverse events. The absence of standardised anaesthesia guidelines necessitates reliance on individual anaesthesiologists' experience, potentially leading to variations in care. Paediatric anaesthesia in this setting poses additional challenges due to the need for accurate drug dosing, managing smaller airways, and addressing the physiological vulnerabilities of children.

This case series examines anaesthetic techniques, complications, and patient outcomes during a surgical camp for children with clubfoot. The findings of this study can contribute to the development of evidence-based guidelines for anaesthesia in resource-constrained settings, improving patient safety and optimising outcomes in these challenging environments.

CASE SERIES

This case series comprised 10 cases aged 1 to 11 years who underwent clubfoot surgery. The surgeries were conducted as part of a paediatric orthopaedic camp during 2023-2024 in one of the remote locales of northeastern India (Tura, West Garo Hills, Meghalaya), which has poor healthcare facilities. These surgeries were part of a special outreach initiative organised by the District Early Intervention Centre (DEIC) under the Rashtriya Bal Swasthya Karyakram (RBSK), National Health Mission (NHM), Tura, Health and Family Welfare, Government of Meghalaya, in collaboration with Dr. Chandramma Dayananda Sagar Institute of Medical Education and Research (CDSIMER), Harohalli, and Holy Cross Hospital, Tura, Meghalaya.

A total of five camps were organised over this period, with the first camp dedicated to screening eligible cases and surveying logistics. All patients were examined preoperatively and screened for other congenital abnormalities. During a preliminary clubfoot screening camp, an anaesthesiologist evaluated these cases, and logistics and equipment issues were noted. Efforts were made to ensure the availability of life-saving drugs and oxygen. The orthopaedic team shortlisted the eligible cases, and they were scheduled for corrective surgeries.

Logistical difficulties, including ensuring an adequate supply of necessary equipment and medications, compounded the challenges of managing anaesthesia and pain in these patients. The nearest available referral centres are at least six hours away from these locations.

However, authors were able to safely and confidently provide anaesthesia care with the help of modern anaesthesia workstations and multipara monitors. Their use was limited due to a shortage of inhalational agents, which compelled us to rely on low-flow anaesthesia along with a regional anaesthesia method. Airway management became challenging as some sizes of endotracheal tubes and Laryngeal Mask Airways (LMAs) were not available. Restocking these tubes took at least 12 hours from the nearest cities. Therefore, multimodal anaesthesia was decided to ensure the safety of these children. Spinal anaesthesia helped us reduce and optimise drug usage, which was also evident in the perioperative use of analgesics.

Informed consent was obtained, and the Nil Per Os (NPO) status of all patients was verified before surgery. Premedication, such

as intravenous midazolam (0.05 mg/kg) or ketamine (0.1-0.25 mg/kg) and glycopyrrolate (0.01 mg/kg), was administered in the preparation room. The infant or child was then swiftly transferred to the operating room. Upon arrival, monitoring equipment like ECG, pulse oximetry, blood pressure, and $ETCO_2$ was attached. General anaesthesia was then initiated in all patients through intravenous administration of propofol and atracurium, with dosages adjusted according to patient weight.

Once the airway was secured, patients were positioned laterally, and hyperbaric bupivacaine was injected at the L4-L5 interspace using a 27-gauge Quincke needle. The dose of bupivacaine was 0.5 mg/kg [4]. Standard American Society of Anaesthesiologists (ASA) monitoring was used to monitor the patients. No significant fall in blood pressure or heart rate was noted after the spinal anaesthesia. There was no sympathetic response to the incision, and the patients remained haemodynamically stable throughout the procedure. Inj. paracetamol 20 mg/kg i.v. was administered intraoperatively. Emergence from anaesthesia and extubation were smooth. The following data were recorded: demographics (age, weight, sex), preoperative assessment, anaesthetic techniques, surgical procedure, and duration of surgery [Table/Fig-1].

All patients had a Face, Legs, Activity, Cry, and Consolability (FLACC) score of less than two immediately after the surgery. The average time to the first rescue analgesic was two hours postoperatively. Most patients effectively managed postoperative pain with intravenous paracetamol (20 mg/kg) or tramadol (1 mg/kg), resulting in an average FLACC score of 3. However, one patient experienced persistent pain, with FLACC scores consistently between 5 and 6 for the first 24 hours, despite receiving paracetamol and tramadol. In this case, intravenous diclofenac (0.5 mg/kg) was administered for adequate pain relief. Postoperative recovery was uneventful, no major complications such as severe hypotension, Post-Dural Puncture Headache (PDPH), or Transient Neurological Symptoms (TNS) were observed. Postoperative Nausea and Vomiting (PONV) was observed only in one case, which responded well to ondansetron.

DISCUSSION

Surgical outreach camps play a crucial role in delivering healthcare to underserved populations in remote regions. Despite these efforts, an estimated 1.7 billion children worldwide still lack access to safe surgical and anaesthetic care due to limitations in infrastructure and workforce [5]. The success of these initiatives heavily depends on careful planning, thorough preparation, and close collaboration with local hospitals and communities [3]. This case series highlights the specific challenges of providing anaesthesia to children in these resource-limited settings.

Effective management necessitates a multidisciplinary approach. Present study findings are supported by Runnels ST et al., who advocate for hybrid models that combine immediate clinical care with long-term health system development in low- and middle-income countries. These models help mitigate ethical concerns associated with short-term missions and contribute to sustainable improvements in local healthcare delivery [5]. In a study by Bhattarai B, author emphasises the need for practical expertise and clinical flexibility in the absence of standardised resources. Similarly, present study reflects the importance of clinical judgment and team-based care in ensuring patient safety under constrained conditions [3].

This case series demonstrates the successful utilisation of spinal anaesthesia combined with general anaesthesia in children. This success is attributed to meticulous preoperative planning, vigilant

S. No.	Age (years)	Sex	Weight (kg)	Diagnosis	Surgery	Duration (hrs)	Co-morbidity	Anaesthesia	Spinal Dose (mL)	Pain Score (12h)	Rescue analgesic
1	1	M	10	Left CTEV	Left tendo achilles tenotomy and corrective cast application	1	Nil	GA with spontaneous ventilation + Spinal	1.0	2	—
2	1	F	9	Bilateral CTEV	Bilateral tendo achilles tenotomy and corrective cast application	1	Nil	GA with spontaneous ventilation + Spinal	1.0	2	—
3	2.5	M	11	Bilateral CTEV	Bilateral posteromedial soft-tissue release	1	Nil	GA/ETT uncuffed 4.5 / Spinal	1.2	3	—
4	3	F	11	Bilateral CTEV	Bilateral posteromedial soft-tissue release	1	Nil	GA/LMA / Spinal	1.2	2	—
5	3.3	M	14	Bilateral neglected CTEV	Posteromedial soft-tissue release with tibialis anterior transfer (2 hrs each side; total 4 h)	4	Nil	GA/ETT 4 uncuffed / Spinal	1.4	4	Inj. tramadol i.v.
6	5	F	14	Bilateral CTEV	Posteromedial soft-tissue release with tibialis anterior transfer (2 hrs each side; total 4 h)	4	Cerebral palsy	GA/ETT 4 uncuffed / Spinal	1.4	2	—
7	6	F	14	Right CTEV	Posteromedial soft-tissue release	1	Poliomyelitis	GA/ETT 4.5 uncuffed / Spinal	1.4	3	—
8	8	M	22	Bilateral CTEV	Gastrocnemius transposition, CTEV repair, contracture release	3	Down syndrome	GA / 5.5 / Spinal	2.2	2	—
9	10	M	28	Bilateral CTEV	Left knee - 8 plating	2	Arthrogryposis multiplex congenita	GA / 6 cuffed / Spinal	2.0	3	—
10	11	F	30	Bilateral CTEV	Posteromedial soft-tissue release, medial column lengthening with lateral column shortening (2 hrs each side; total 4 hrs)	4	Nil	GA / 6 cuffed / Spinal	3.0	4	Inj. tramadol i.v., Inj. diclofenac i.v.

[Table/Fig-1]: Summarises demographic and clinical data of patients undergoing paediatric CTEV surgeries at the outreach camp, including anesthesia techniques, spinal doses, pain scores at 12 hours, and rescue analgesic use.
CTEV: Congenital Talipes Equino-Varus; GA: General Anaesthesia; ETT: Endotracheal tube; M: Male; F: Female; [Table/Fig-1] summarises demographic and clinical data of patients undergoing paediatric CTEV surgeries at the outreach camp, including anaesthesia techniques, spinal doses, pain scores at 12 hours, and rescue analgesic use

patient monitoring, and the implementation of standardised protocols. However, limitations include restricted access to diagnostic tools, difficulties in obtaining accurate patient histories, and the potential presence of undiagnosed medical conditions or malnutrition, which can significantly increase anaesthetic risks [3].

Children present unique anaesthetic challenges due to their small size, unpredictable physiology, and the potential for rapid changes in their cardiovascular system. To address these challenges, present study employed a combined approach, utilising spinal anaesthesia in conjunction with general anaesthesia. This approach reduces reliance on inhalational agents and advanced ventilators while also providing excellent postoperative pain relief, minimising the need for opioids, and improving hemodynamic stability.

Although the description of spinal anaesthesia in children was first made by August Bier in 1898 [6], it has been used sparingly, likely due to a lack of expertise or fear of complications. In recent years, spinal anaesthesia in infants and children has regained popularity with a greater understanding of possible complications and improved expertise in performing the procedure. Spinal anaesthesia in ex-premature infants confers a distinct advantage by reducing the incidence of postoperative apnoea and bradycardia, as demonstrated by Abajian JC et al., [7].

The dose of spinal bupivacaine is higher in infants and children compared to adults due to a higher turnover of cerebrospinal fluid and increased absorption of the local anaesthetic. Children typically do not experience a reduction in blood pressure or heart rate after spinal anaesthesia [8], which is a distinct advantage compared to adults. The incidence of PDPH is also very low in the paediatric population [9].

Recent literature, including work by Garcia K et al., and Mir SA et al., confirms the safety and efficacy of spinal anaesthesia in infants and high-risk paediatric groups. Benefits include fewer respiratory complications, reduced duration of anaesthesia, and lower opioid requirements [10,11]. Quality improvement initiatives have further demonstrated reductions in recovery time, complications, and healthcare costs when spinal anaesthesia is applied to common urologic procedures [12]. In a study by AlSuhebani M et al., spinal anaesthesia alone was successfully used in infants undergoing Achilles tendon lengthening. No intraoperative sedation or postoperative analgesia was required, and all patients maintained stable haemodynamic and respiratory parameters. These findings underscore the utility of spinal anaesthesia as a viable alternative to general anaesthesia, particularly in low-resource environments [13].

The availability of specific guidelines for anaesthesia in outreach camps would be invaluable for both experienced and novice anaesthesiologists participating in these critical endeavours. Before the camp, we diligently followed a comprehensive checklist that ensured readiness across all essential aspects of anaesthesia management [Table/Fig-2]. Authors highly recommend that this or a similar checklist be verified before organising similar events in challenging environments.

Category	Items
Airway equipment	Endotracheal tubes, Laryngeal Mask Airway (LMA), laryngoscope, face mask, oral and nasal airways, Ambu-bag, suction
Breathing circuits	Paediatric circuits, Jackson -Rees circuits
Back-up facility	Oxygen (cylinders, manifold and pipeline with bulk cylinders or Pressure Swing Adsorption O_2 generators, O_2 concentrators), laboratory, pharmacy, blood bank, X-ray
Communication system	-
Drugs	Intravenous fluids, intravenous anaesthetics, inhalational anaesthetics, neuromuscular blocking drugs, analgesics
Emergency drugs	Atropine, epinephrine, norepinephrine, ephedrine or vasopressors
Difficult airway aid	Bougie, stylet, cricothyroidotomy set, tracheostomy set
Defibrillator	-
Surgical scope	Discuss surgical scope with local coordinator
Electricity backup	Uninterruptible Power Supply (UPS), generator units, solar power
Monitors	Non-invasive Blood pressure , pulse oximeter, Electrocardiogram (ECG), capnography, stethoscope, temperature monitoring
Others	Drip sets, i.v. cannula, plasters, warming devices
Preoperative screening	To identify risk cases

[Table/Fig-2]: Recommended equipment and resource checklist for outreach surgical camps.
This checklist outlines essential equipment, medications, monitoring, and logistical considerations necessary for safe and effective anaesthesia care in outreach surgical camps. It serves as a practical guide for anaesthesiologists and support staff working in resource-limited settings.

CONCLUSION(S)

This study highlights the successful anaesthetic management of paediatric patients undergoing clubfoot surgery in a resource-limited camp setting. Despite the constraints, careful planning and execution ensured favourable outcomes. These findings emphasise the need for continued efforts to optimise anaesthesia services in surgical camps, including training, resource allocation, and adherence to standardised protocols. Spinal anaesthesia is an extremely effective adjuvant for pain relief in children undergoing lower extremity surgery under general anaesthesia. When performed correctly in children, this procedure is generally safe and does not typically cause the haemodynamic complications seen in adults, while also lowering the required opioid dosage. Further research is needed to develop and evaluate standardised guidelines for anaesthesia in outreach surgical camps. Telemedicine can improve patient care in developing countries, particularly in the context of surgical outreach programs, by streamlining processes like patient screening, preoperative assessments, and postoperative monitoring.

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