

## CASE REPORT

# Feasibility of Using iTIVA™ Mobile Application as Intraoperative Infusion Guide in Pediatric

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### ABSTRACT

**Background:** Total intravenous anaesthesia (TIVA) is increasingly popular in paediatric anaesthesia. It can be administered manually or via target-controlled infusion (TCI). However, TCI pumps with specialised paediatric pharmacokinetic (PK) models are not widely available. iTIVA™ is a mobile application that simulates TCI infusion regimens using various PK models, including paediatric ones. The application is available for iOS and Android devices. We report our experience using iTIVA as an intraoperative infusion guide.

**Case illustration:** A 12-year-old boy with body weight of 53 kg and 153 cm tall, physical status ASA II, presented with tethered cord syndrome due to lipomyelomeningocele and was scheduled for untethering surgery. Anaesthesia was induced and maintained with TIVA using propofol guided by Eleveld model on Mindray TCI pump and remifentanyl guided by the Eleveld model simulated with iTIVA application. The initial target, desired plasma or effect concentration were selected, and the application determined the required infusion rates for remifentanyl. The Bispectral index (BIS) monitoring was used to assess the depth of anaesthesia. No adverse events were observed during the surgery. The patient was transferred to the recovery room and discharged from the hospital on the second postoperative day.

**Conclusion:** iTIVA offers a practical and accurate alternative for simulating TCI infusion regimens when specialised pumps are unavailable.

**Keywords:** Intraoperative; iTIVA; paediatric; TCI; TIVA.

## INTRODUCTION

Despite the advantages of TIVA in children, it is not yet a routine anaesthetic technique in children. This may be due to the limited availability of the target-control infusion system and unfamiliarity with the technique.<sup>1</sup>

iTIVA is an application for iOS and Android operating systems with a pharmacokinetic model-based algorithm for calculating manual infusion regimens to achieve plasma and effect site concentrations that may be used in the volume infusion pumps.<sup>2</sup> The iTIVA enables simulation of target-controlled infusion (TCI) by integrating 31 validated pharmacokinetic models covering 11 intravenous agents, and interfaces with standard volumetric pumps to facilitate TCI administration.<sup>3</sup> Practical example for using TIVA in children are illustrated in the following case presentation.

## CASE ILLUSTRATION

A 12-year-old boy weighing 53 kg and 153 cm tall, with an ASA physical status of II, presented with tethered cord syndrome due to lipomyelomeningocele and was scheduled for untethering surgery. Upon arrival in the operating room, ECG, non-invasive blood pressure (NIBP), pulse

oximetry, temperature, and bispectral index (BIS) monitoring were applied. NIBP was measured at 3-minutes interval during anaesthesia and BIS values were automatically recorded.

The patient's data – age, sex, weight (kg) and height (cm) – were entered into the iTIVA application. Remifentanyl, as an analgesic agent, was selected using the Eleveld models. The induction time was set to 2 minutes with a starting target concentration of 5 ng/ml and a maintenance target of 3 ng/ml. The desired effect-site concentration (Ce) was set at level 4. After entering all the data, the application displayed the remifentanyl infusion rates at specific times. The remifentanyl infusion rate was then adjusted manually using the syringe pump according to the app's guidance. Propofol administration, also based on the Eleveld model, was delivered using Mindray TCI pump with the initial target concentration of 3 ng/ml, then titrated as needed.

At the second minute of infusion, endotracheal intubation was performed with use of muscle relaxants, Rocuronium 1 mg/kg. Laryngoscopy revealed a Cormack-Lehane grade I view and the trachea was intubated smoothly with with

a non-kinking endotracheal tube size 6.5. The tube was secured and the patient was positioned prone. Additional pads were placed under bony prominences and pillows were placed under the chest and pelvis to prevent pressure injury during surgery.

For anaesthesia maintenance, the remifentanyl infusion was adjusted based on the application's scheme. The propofol infusion rate was adjusted to maintain the BIS values between 40 and 50.



**Figure 1.** Schematic remifentanyl infusion rate of iTIVA

Intravenous crystalloid infusion was titrated to maintain MAP within the desired age-related range. The lungs were mechanically ventilated with a mixture of oxygen and air (FiO<sub>2</sub> 50%), using a tidal volume 6–8 ml/kg and a respiratory rate of 10–14 breaths/min to maintain an end-tidal CO<sub>2</sub> between 30–35 mmHg. The patient received intravenous dexamethasone 5 mg and metoclopramide 10 mg intraoperatively.

The surgery lasted 5 hours and 30 minutes. There were no adverse events such as hypotension and bradycardia during the procedure. Total blood loss was 150 ml and urine output was 0.92 ml/kg/hour. The patient regained consciousness swiftly after the end of the infusion and was extubated.

## DISCUSSION

Using TIVA in paediatric cases provides several advantages compared to volatile anaesthesia. Benefits for patients include lower rates of postoperative nausea and vomiting (PONV), reduced delirium, shorter recovery times, and decreased airway irritation. It is a safe anaesthesia option for children with specific conditions that prevent the use of volatile agents. Additionally, TIVA offers

environmental advantages over volatile anaesthesia and can be beneficial during surgeries that require somatosensory monitoring.<sup>4,5</sup>

A full TIVA procedure involves inserting an intravenous catheter without relying on inhaled anaesthetics. Establishing the best conditions for intravenous placement in a child can be difficult.<sup>6</sup>

iTIVA can be useful for simulating TCI infusion scheme when specialised TCI pumps are unavailable. There have been concerns about awareness when TIVA is used in children.<sup>6</sup> We use BIS to optimise anaesthetic delivery, minimise adverse effects, and maximise safety. Monitoring with the BIS has been shown to shorten the time to extubation, improve orientation to time and place, and expedite discharge from both the operating room and the post-anesthetic care unit.<sup>7</sup>

Ramirez demonstrated the algorithm implemented in the iTIVA application for iOS and Android operating systems (for remifentanyl and propofol) resulted in less than a 5% average systemic deviation from the target effect-site concentration during both induction and maintenance.<sup>2</sup>

This application has two modes, simulation and TCI mode. In the TCI mode, the user inputs the desired plasma concentrations and the application calculates the necessary infusion rates for the selected drugs based on the pharmacologic model and patient parameters. It also offers a list of recommended target concentrations, allowing the user to design and administer anesthesia according to the app's calculated infusion plans (expressed in mL/hour or  $\mu\text{g/kg/min}$ ). This mode include graphical displays showing the predicted likelihood of awareness and responses to intubation or incision. Additionally, the application can estimate the time to awakening by determining how long it will take to reach a specific effect-site concentration.<sup>8,9</sup>

An ideal mobile application for intraoperative monitoring should be easy to use, accurate, non-invasive, cost-effective, and reliable.<sup>10,11</sup> Compared with paediatric TCI pump, iTIVA is relatively easy to use, non-invasive, reliable (less than 5% standard deviation) and affordable (Rp. 193,000 per year subscription fee). The developer has also

provided a free online video tutorial for iTIVA.<sup>2</sup>

In developing nations such as Indonesia, where financial limitations restrict access to advanced technology, an app-based TCI system can serve as an affordable and user-friendly alternative to traditional TCI pumps.

In the recent study, the amount of propofol delivered through the TCI pump was comparable to the volume calculated by iTIVA over the same time frames, supporting the practical use of iTIVA in routine anesthesia care without risking patient safety.<sup>3</sup>

This mobile application also serves as an excellent educational aid for learning about TIVA and TCI principles. The developer has included several well-established TCI models in the application, enabling adjustments tailored to specific patient groups (such as elderly, or obese individuals). Upon selecting a TCI model, the application offers a brief description along with a reference to the original research.<sup>2</sup> While the TCI mode may initially seem the most practical, it less suitable for regular use in a busy operating room setting. In contrast to an actual TCI pump, there is a risk that users may

become distracted or too focused on the app while simultaneously managing anesthesia.<sup>2</sup>

## CONCLUSION

In summary, iTIVA offers a practical and accurate alternative for simulating TCI infusion regimens when specialised pumps are unavailable. BIS-guided TIVA optimises anaesthetic delivery, reduces adverse effects, and enhances safety. The application's features enable precise dosing and awakening predictions. iTIVA is a reliable, user-friendly, and cost-effective tool if specialized TCI pumps are unavailable.

## CONFLICT OF INTEREST

There is no conflict of interests and funding.

## REFERENCE

1. Yuen V M. Pediatric TIVA/TCI: Case presentations and discussion. In: Absalom A, Mason K (eds). Total intravenous anesthesia and target controlled infusions. Springer, Cham. 2017;391–491. Available in [https://doi.org/10.1007/978-3-319-47609-4\\_22](https://doi.org/10.1007/978-3-319-47609-4_22).
2. Ramirez DE, Calvache JA. Design and performance evaluation of the “iTIVA” algorithm for manual

- infusion of intravenous anesthetics based on effect-site target. *Colombian Journal of Anesthesiology*. 2016;44(2):105–13.
3. Shah SB, Chawla R, Gupta M. Target-controlled infusion: A comparative, prospective, observational study of the conventional TCI pump and the novel smartphone-based application iTIVA. *J Anaesthesiol Clin Pharmacol*. 2024 Jan-Mar;40(1):114–19.
  4. Greenaway S, Lewis H. Total intravenous anaesthesia in children: a practical guide. *Anaesthesia & Intensive Care Medicine*. 2025;26(3):168–74.
  5. Barrowman J, Wilson M. Total intravenous anaesthesia. *Anaesthesia & Intensive Care Medicine*. 2022;23(1):54–9.
  6. Kleevens S, Saldien V. Total intravenous anesthesia for the pediatric patient: a narrative review. *Acta Anaesth Bel*. 2024;75(1):147–70.
  7. Oliveira CRD, Bernardo WM, Nunes VM, Benefit of general anesthesia monitored by bispectral index compared with monitoring guided only by clinical parameters. Systematic review and meta-analysis. *Brazilian Journal of Anesthesiology*. 2017;67(1):72–84.
  8. Sahinovic MM, Struys MMRF, Absalom AR. Clinical pharmacokinetics and pharmacodynamics of propofol. *Clin Pharmacokinet*. 2018 Dec;57(12):1539–58.
  9. Hackmann T, MacDonald DBS. iTIVA anesthesia. *Can J Anesth*. 2015; 62:1231–32.
  10. Anderson BJ, Bagshaw O. Practicalities of total intravenous anesthesia and target-controlled infusion in children. *Anesthesiology* 2019;131(1):164–85.
  11. Pan S, Rong LQ. Mobile applications in clinical and perioperative care for anesthesia: narrative review. *J Med Internet Res*. 2021;23(9):e25115.