Case Report

Anesthetic challenges in pediatric robot-assisted surgeries

ABSTRACT

With the advent of minimally invasive surgeries, robot-assisted techniques have gained popularity because they overcome various shortcomings of standard laparoscopic surgeries. Despite the associated costs and limitations among the pediatric population, surgeon comfort due to the ergonomic design, in combination with enhanced three-dimensional high-fidelity imaging and tissue handling, may offer better surgical and postoperative outcomes. However, robotic surgeries require innovations with regard to patient positioning and the overall arrangement of operative equipment and personnel. Anesthesiologists should become well versed with these changes by learning the basic features of robotic surgical systems to offer appropriate anesthetic care and promote patient safety. In this original case report, we present a 3-year-old child posted for robot-assisted left heminephrectomy and excision of the lower megaureter. It provides instructive significance for anesthesia management, especially taking into account the age of the patient and associated concerns.

Key words: Da Vinci surgical system, pediatric anesthesia, pediatric robot-assisted surgeries, patient ergonomics, patient safety

Introduction

Following the first report of robotic-assisted surgery in a pediatric patient in 2002, its applications in children have expanded to include multiple procedures and specialties such as urology, general pediatric surgery, and cardiothoracic surgery for patients from infants to adolescents.[1] Although robot-assisted surgeries in pediatrics are still slowly picking up pace, currently, the most common robotic operations in practice are pyeloplasties and fundoplications.[2]

This case report describes the unique challenges we faced with regard to the fact that the patient is of the pediatric age group and the daunting task of safely accommodating the patient, operating personnel, and the da Vinci surgical system in the OT.

Case Report

A 3-year-old female child without comorbidities presented with history of recurrent febrile urinary tract infections over the course of 1 year. She had an uneventful birth history and had attained all her developmental milestones for age. On examination, her vitals were within normal limits for age and she weighed 15 kg. Systemic examination was normal, except for per abdomen findings, which indicated abdominal distension and fullness in the left flank extending till the suprapubic region. Computed tomography abdomen showed the left duplex collecting system with a

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Annet S. Abraham, Sanjay Gupta

Department of Anaesthesia and Pain Management, Max Super Speciality Hospital, Saket, New Delhi, India

Address for correspondence: Dr. Annet S. Abraham, KDPMRA-56, Thaarakayil, Kesavadasapuram, Pattom P.O, Trivandrum - 695 004, Kerala, India.
E-mail: annetabraham92@gmail.com

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dilated obstructed upper moiety collecting system with an ectopic opening. A diagnosis of the duplex left kidney with a nonfunctioning upper moiety and dilated ureter was made accordingly. The child was subsequently posted for robot-assisted left heminephrectomy and excision of the lower megaureter.

Preoperatively, the child's parents were counseled regarding the surgery and anesthetic plan of management and their informed consent was taken. Prilox was applied on the dorsum of both hands half hour prior to shifting into the OT. Prior to induction of anesthesia, a 24 G IV cannula was secured on the dorsum of the left hand since the patient was to be positioned with the left side up. Intraoperative monitoring included electrocardiogram, pulse oximetry, temperature, capnography, and invasive BP (arterial line secured in the right radial artery after induction). Intravenous induction was performed with Inj. Propofol 30 mg and airway secured with a cuffed endotracheal tube (ETT) of size 4.0 mm ID. Atracurium infusion was started at 6 mg/h. Maintenance of anesthesia was done with oxygen, air, and sevoflurane. The pneumoperitoneum was created using the Endovision port, and thereafter, the camera port was placed 9 cm from the costal margin. The rest of the two working ports were placed under vision 8 cm from the camera port in cephalad and caudad positions. A 10 mm assistant port was placed between the left port and camera port. In total, five ports were placed in the abdomen [Image 1].

Image 1: Da Vinci surgical system docked

Patient positioning was carefully done with gamgee padding for arms and hands. Eyes were also further padded and taped with tegaderm, with regular intraoperative checks. Positioning and securing of lines were done at the most accessible points [Image 2].

The surgery lasted for a duration of 4.5 hours. Undocking was initiated while the patient was still on atracurium infusion, and it was stopped only after complete undocking of ports. Local anesthetic infiltration of the port site was done prior to extubation. Administration of reversal and airway extubation were performed half hour after cessation of infusion. At 4 hours postoperatively, the child was allowed to start oral liquid diet. Analgesia was covered with Inj. Paracetamol 150 mg IV Q8H, and the patient remained pain free throughout the recovery period. Early mobilization was encouraged; the entire postoperative course was uneventful. She was discharged 3 days after surgery.

Discussion

The various advantages of robot-assisted surgery include minimal blood loss, reduced postoperative pain, shorter hospital stay, reduced wound access trauma, improved cosmesis, increased cost-efficacy, better visualization with stereoscopic views, elimination of hand tremor allowing greater precision, and improved manoeuvring as a result of the "robotic wrist".[3] Central concerns for the anesthesiologist revolve around patient positioning to prevent peripheral nerve and soft tissue injuries, limited patient access after docking, pneumoperitoneum and associated changes, fluid and analgesia management, risk of venous air embolism, maintenance of normothermia, injury during trocar placement since the pediatric abdomen is more compliant, and occult blood loss. As pediatric urologic procedures require use of irrigation fluid, it makes

Image 2: Patient positioning prior to docking

the estimation of blood loss more difficult and also adds up to the risk of development of hypothermia.[4]

Patient positioning requires meticulous attention with padding at pressure points. The ETT must be secured firmly. As per the recommendation by the Italian Society of Pediatric and Neonatal Anesthesia and Intensive Care (SARNePI) and the Italian Society of Pediatric Surgery (SICP), it is advisable to keep one arm freely accessible to the anesthesiologist, whenever possible. Strategies to reduce postoperative nausea and vomiting include adequate hydration and administration of dexamethasone 0.1 mg/kg. Adequate intravenous access must be ensured with long tubing IV catheters and arterial lines and checked for the absence of kinks or potential obstructions.[5]

A multimodal analgesic strategy involving local anesthetic infiltration of port sites, instillation into the retroperitoneal space, intravenous analgesics, and opioids should be formulated. Patient movement may cause significant patient injury once the robot is docked. Hence, muscle paralysis is always reversed administration after undocking. Robot setup and patient positioning takes time and experience.

Though the da Vinci system is heavy and bulky for small-sized children, the ergonomic limitations can be overcome and managed through effective teamwork, increased surgical volume, and experience.[6]

Good communication among surgeons, anesthesiologists, and nurses is key. Critical incidents (cardiac arrest for example) require special consideration, and practice drills are to be included to smoothly facilitate emergency undocking and cardiopulmonary resuscitation in such events.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient's parents have given their consent for her images and other clinical information to be reported in the journal. The patient's parents' understand that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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