

Pediatric Robotic Surgery in the Philippines: Initial Experience and Early Outcomes

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Research Article

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Abstract

Background:

Pediatric robotic surgery has expanded globally but remains under-reported in low- and middle-income countries. We report the first Philippine series of pediatric robotic-assisted general surgery, describing early program implementation and 30-day outcomes in a public tertiary referral center.

Methods:

A retrospective descriptive case series was conducted of pediatric patients (less than 19 years-old) who underwent robotic-assisted surgery between September 2024 and October 2025. Demographic characteristics, operative metrics (docking time, console time, total operative time, and estimated blood loss), as well as short-term postoperative outcomes, were summarized descriptively.

Results:

Nine pediatric robotic procedures were performed using the da Vinci platform: four choledochal cyst excisions with hepaticoduodenostomy, two robotic-assisted anorectal pull-throughs for anorectal malformation, two total proctocolectomies (ulcerative colitis; familial adenomatous polyposis), and one ovarian oophorocystectomy. Age ranged from 2–16 years; the lowest weight was 12.7 kg. Median docking, console, and total operative times were 26 (10–45), 195 (70–480), and 272 (145–610) minutes, respectively. Median estimated blood loss was 60 (10–150) mL. There were no unplanned conversions or intraoperative complications. One postoperative complication occurred (chylous leak, Clavien–Dindo II) managed conservatively. No Clavien–Dindo $\geq$ III complications, mortality, or unplanned ICU admissions occurred; all patients completed 30-day follow-up.

Conclusion:

Pediatric robotic surgery was feasible with acceptable 30-day outcomes during early implementation in a resource-constrained public healthcare setting. Operative metrics and morbidity were within ranges reported in published pediatric robotic series. Continued case accrual and longer follow-up are required to evaluate functional outcomes, cost implications, and long-term program sustainability.

INTRODUCTION

Minimally invasive techniques are now routinely used in many areas of pediatric surgery. In selected conditions, laparoscopic approaches are associated with faster recovery, less postoperative pain, and improved perioperative outcomes compared with open procedures. Despite these benefits, complex operations in children remain demanding. Small patient size, limited intra-abdominal working space, and

reliance on straight laparoscopic instruments may complicate delicate reconstruction, particularly during deep pelvic or complex abdominal surgery. Robotic systems were developed to overcome some of these limitations by increasing instrument mobility and improving visual control during minimally invasive procedures.(1)

Early adoption of robotic technology in pediatric surgery occurred primarily within urologic procedures, with gradual expansion into general pediatric surgical applications. (1, 2) Establishing a pediatric robotic program requires institutional investment, operating room workflow adaptation, team training, and structured case selection. Published implementation experiences emphasize that safe integration depends not only on technology acquisition but also on multidisciplinary coordination and progressive escalation of case complexity. In resource-limited healthcare systems, financial constraints and competing service priorities may delay adoption despite potential technical benefits. (3, 4)

Clinical experience with pediatric robotic surgery has expanded beyond urology to include selected hepatobiliary and colorectal procedures. In choledochal cyst excision, comparative analyses have demonstrated perioperative outcomes similar to laparoscopy, with safe reconstruction and acceptable morbidity profiles. (5) Robotic-assisted pull-through procedures for anorectal malformation have likewise been reported as technically feasible, particularly during deep pelvic dissection.(6) Despite these encouraging findings, most published data originate from high-resource settings, and experience from low- and middle-income countries remains limited.

Published data on pediatric robotic surgery from Southeast Asia are limited, and to date, no published pediatric robotic series has been reported from the Philippines. In 2024, University of the Philippines–Philippine General Hospital performed the country’s first general pediatric robotic operation—a robotic-assisted choledochal cyst excision in a 10-year-old child. This case series represents the first documented pediatric robotic surgery experience in the Philippines, focusing on feasibility, safety, and short-term outcomes.

METHODS

This study is a retrospective descriptive case series of pediatric patients who underwent robotic-assisted surgery at a public tertiary referral center in the Philippines following the introduction of a pediatric robotic surgery program. All consecutive patients aged < 19 years who underwent robotic-assisted surgery between September 2024 and October 2025 were included. There were no exclusion criteria. Demographic, clinical, and perioperative data were extracted from electronic medical records and operative logs by the primary investigator and cross-checked for accuracy prior to analysis. All patients were followed for a minimum of 30 days postoperatively and outpatient clinic records were reviewed.

Operative and perioperative variables collected included the type of robotic procedure performed, robotic platform used, docking time, console time, and total operative time, estimated intraoperative blood loss, conversion to laparoscopic or open surgery, intraoperative and postoperative complications, time to full

oral intake, duration of postoperative pain control, and postoperative length of hospital stay. Postoperative complications were classified according to the Clavien-Dindo classification and recorded within 30 days of surgery. All data were anonymized prior to analysis. Data were analyzed descriptively, with continuous variables reported as medians with ranges and categorical variables summarized as frequencies and percentages. No comparative statistical analyses were performed due to the descriptive nature of the study.

This study was conducted in accordance with the STROCSS 2021 guidelines for reporting surgical case series. Ethical approval was obtained from the University of the Philippines Manila Research Ethics Board.

RESULTS

Overall Cohort Characteristics

A total of nine pediatric patients underwent robotic-assisted surgical procedures during the study period. The cohort included 5 males and 4 females, with a median age of 6 years (range 2–16) and median weight of 19.5 kg (range 12.7–58.0). All procedures were performed electively at a public tertiary referral center using the da Vinci robotic system (Intuitive Surgical, Sunnyvale, CA, USA), the 8 cases in the da Vinci Si and one in the da Vinci Xi (total proctocolectomy). All procedures were performed by a single pediatric surgeon as the primary console operator.

Surgical procedures included choledochal cyst excision ($n = 4$), robot-assisted anorectal pullthrough (RAARP) for anorectal malformation ($n = 2$), robotic total proctocolectomy for infantile inflammatory bowel disease and familial polyposis syndrome ($n = 2$), and robotic unilateral oophorocystectomy for ovarian teratoma ($n = 1$). All cases were completed robotically, with no unplanned conversions to laparoscopic or open surgery.

Table 1
Baseline demographic characteristics

Number of patients	n: 9
Age (years)	median: 6 (range: 2–16)
Sex (male : female)	5 : 4
Weight (kg)	median: 19.5 (range: 12.7–58)
Type of surgical procedure	
choledochal cyst excision	n: 4
anorectal pullthrough for anorectal malformation (RAARP)	n: 2
total proctocolectomy	n: 2
unilateral oophorocystectomy	n: 1

Robotic choledochal cyst excision

Four patients underwent robotic-assisted excision of choledochal cysts. All cases involved Todani type I cysts, with widest cyst diameters ranging from 14 to 53 mm. Patient ages ranged from 3 to 10 years, with weights between 14.2 and 38.0 kg. Three patients were female and one was male.

Hepaticoduodenostomy was the biliary–enteric reconstruction performed in all four cases. All cases were performed robotically in the da Vinci Si system using three 8-mm ports, one 12-mm optical port and one 5-mm assist port.

Docking time ranged from 10 to 45 minutes, console time from 210 to 480 minutes, and total operative time from 240 to 545 minutes. A reduction in docking time, console time, and total operative time was observed across sequential cases.

Estimated intraoperative blood loss ranged from 25 to 150 mL, and no patient required intraoperative or postoperative blood transfusion. There were no recorded intraoperative complications and no conversions to laparoscopic or open surgery.

Postoperative length of stay ranged from 5 to 8 days. Duration of intravenous analgesia ranged from 2 to 6 days. Only one patient required postoperative parenteral opioid administration. Time to full enteral feeding ranged from 3 to 6 days.

No postoperative complications or reinterventions were recorded. All patients were reviewed at 30-day follow-up and were clinically well.

Table 2
Operative and Postoperative Outcomes of Robotic Choledochal Cyst Excision (Individual Patient Data)

Variable	Case 1	Case 2	Case 3	Case 4
Age (years) / Sex	10 / F	6 / F	6 / F	3 / M
Weight (kg)	38.0	19.5	18.3	14.2
Widest cyst diameter (mm)	45	53	25	14
Docking time (min)	45	30	20	10
Console time (min)	480	415	210	210
Total operative time (min)	545	485	250	240
Estimated blood loss (mL)	150	150	50	25
Postoperative length of stay (days)	7	7	8	5
Postoperative parenteral opioid use (# of doses)	0	4	0	0
Time to full enteral diet (days)	5	6	4	3

- *No intraoperative complications, conversions, or postoperative complications occurred.*
- *No intraoperative or postoperative blood transfusions were required.*
- *All patients were reviewed at 30-day postoperative follow-up without complications.*

Robot-assisted Anorectal pullthrough for Anorectal Malformation

Two patients underwent RAARP for anorectal malformation with recto–bladder neck fistula, following prior diverting colostomies during infancy. Both patients were male, aged 2 and 8 years, with weights of 12.7 kg and 20.4 kg, respectively.

The procedures were performed following the technique of laparoscopy-assisted anorectal pullthrough (LAARP) described by Georgeson et al. (7) Both procedures were done in the da Vinci Si system. Console times were 195 and 190 minutes, while total operative times were 272 and 240 minutes, respectively. There were no intraoperative complications and no conversions to laparoscopic or open surgery.

Postoperative length of hospital stay was 7 and 8 days. Duration of postoperative parenteral analgesia was 3 days in both patients, with 1 and 2 doses of parenteral opioid administered, respectively. Time to full enteral feeding was 4 and 5 days.

No postoperative complications or reinterventions were recorded. Both patients were reviewed at 30-day postoperative follow-up without complications.

Table 3
Operative and Postoperative Outcomes of RAARP

Variable	Case 1	Case 2
Age (years) / Sex	2 / M	8 / M
Weight (kg)	12.7	20.4
Krackenbeck classification of ARM	Recto–bladder neck fistula	Recto–bladder neck fistula
Type of stoma	Descending colostomy	Transverse colostomy
Docking time (min)	32	20
Console time (min)	195	190
Total operative time (min)	272	240
Estimated blood loss (mL)	50	25
Postoperative length of stay (days)	7	8
Postoperative parenteral opioid use (# of doses)	1	2
Time to full diet (days)	4	5

- *No intraoperative complications, conversions, or postoperative complications occurred.*
- *No blood transfusions were required.*
- *Both patients were reviewed at 30-day postoperative follow-up without complications.*

Robot-assisted total proctocolectomy

Two male patients underwent robotic-assisted total proctocolectomy with straight ileoanal anastomosis (SIAA) and diverting ileostomy for infantile ulcerative colitis and familial adenomatous polyposis (FAP), respectively. Patients were aged 6 and 13 years, with weights of 18.5 kg and 24.4 kg, respectively. The first case of infantile ulcerative colitis was done in the da Vinci Si while the case of FAP was performed in the da Vinci Xi.

Docking times were 30 and 16 minutes, console times were 145 and 429 minutes, and total operative times were 609 and 610 minutes, respectively. Estimated intraoperative blood loss was 60 mL and 80 mL, respectively. The patient with infantile ulcerative colitis underwent a combined robotic and laparoscopic approach in the da Vinci Si. The robotic portion was performed for the pelvic and left-sided colonic mobilization and laparoscopy was used in the right-sided colonic dissection. The patient with FAP underwent a pure robotic-assisted procedure in the newer da Vinci Xi system, which allowed multi-quadrant surgery with single docking.

Postoperative length of hospital stay was 8 and 10 days, respectively. The patient with FAP developed a chylous leak noted in the peritoneal drain, which was managed conservatively and classified as Clavien–Dindo grade II. No reoperations were required.

Duration of postoperative intravenous analgesia was 8 and 7 days. Only one patient received a single dose of parenteral opioid. Time to full enteral feeding was 4 and 5 days. Both patients were reviewed at 30-day postoperative follow-up without further complications.

Robot-assisted unilateral oophorocystectomy

One 16-year-old female patient underwent robotic unilateral oophorocystectomy for a right ovarian teratoma. The patient weighed 58 kg.

Docking time was 26 minutes, console time was 70 minutes, and total operative time was 145 minutes. Estimated intraoperative blood loss was 10 mL. The procedure was completed robotically without complication or conversion. Postoperative length of hospital stay was 2 days. The patient was reviewed at 30-day postoperative follow-up without complications.

Table 4

Operative and Postoperative Outcomes of Robotic Total Proctocolectomy and Oophorocystectomy

Variable	Case 1	Case 2	Case 3
Age (years)/ Sex	6/ M	13/ M	16/ F
Weight (kg)	18.5	24.4	58
Diagnosis	Infantile ulcerative colitis	Familial adenomatous polyposis	Right ovarian teratoma
Procedure	Total proctocolectomy, SIAA, ileostomy	Total proctocolectomy, SIAA, ileostomy	Right oophorocystectomy
Docking time (min)	30	16	26
Console time (min)	145	429	70
Total operative time (min)	609	610	145
Estimated blood loss (mL)	60	80	10
Postoperative length of stay (days)	8	10	2
Postoperative parenteral opioid use (# of doses)	0	1	0
Time to full diet (days)	4	5	1
Complications	None	Chylous leak (Clavien-Dindo grade II)	None

Across the entire cohort of nine patients, there were no intraoperative complications and no unplanned conversions to laparoscopic or open surgery. One patient (11%) developed a postoperative complication classified as Clavien-Dindo grade II, which was managed conservatively without reoperation. There were no major postoperative complications (Clavien-Dindo grade III or higher) and no mortality. All patients were reviewed at 30-day postoperative follow-up without additional complications.

Table 5
Summary Operative and Postoperative Outcomes for the Entire Cohort (n = 9)

Variable	Value
Number of patients	9
Docking time (min)	Median: 26 (range: 10–45)
Console time (min)	Median: 195 (range: 70–480)
Total operative time (min)	Median: 272 (range: 145–610)
Estimated blood loss (mL)	Median: 60 (range: 10–150)
Postoperative length of stay (days)	Median: 7 (range: 2–10)
Conversions to lap/open	0 (0%)
Intraoperative complications	0 (0%)
Postoperative complications (overall)	1 (11%)
Clavien-Dindo $\geq$ III complications	0 (0%)
30-day follow-up completed	9 (100%)

DISCUSSION

This report describes the first pediatric robotic surgery case series from the Philippines and presents the early clinical experience of a newly established program in a public tertiary referral center. Although robotic surgery is well integrated into pediatric practice in many high-income settings, published data from LMICs remain limited.

In this initial cohort, all procedures were completed robotically without unplanned conversion, and no major perioperative complications occurred. Operative duration reflected the early phase of program implementation, yet perioperative outcomes were comparable to those reported in previously published pediatric series of robotic hepatobiliary and colorectal surgery. (3, 5, 6, 8–10) These findings suggest that pediatric robotic surgery can be introduced safely in a resource-constrained setting with careful case selection and coordinated implementation.

Feasibility and Safety

The introduction of robotic-assisted surgery into pediatrics requires deliberate planning, team preparation, and careful case selection. In our program, the initial cases were intentionally chosen based on procedural familiarity. All index operations were procedures that the primary surgeon had previously performed laparoscopically with established experience. This approach was adopted to prioritize patient

safety during the early phase of robotic integration and to limit technical variability unrelated to the platform itself.

Adult robotic surgeons with established console experience were also present during the initial cases and served as proctors. Their involvement provided technical oversight and team support, particularly during docking, troubleshooting, and optimization of operative workflow. This structured introduction—built upon prior laparoscopic expertise and multidisciplinary mentorship—likely contributed to the absence of major intraoperative complications and the successful completion of all procedures without conversion.

Similar experiences have been described during early program development in other centers. Pham et al. reported safe initial outcomes in a 39-case series of robotic choledochal cyst excisions in Vietnam, with no conversions or intraoperative complications.(8) Systematic reviews of RAARP have likewise demonstrated feasibility with low perioperative morbidity in selected pediatric patients. (6, 10)

Longer operative times are expected during the early phase of adopting a new platform, particularly while the operating teams become accustomed to docking, port configuration, and console coordination. In our series, operative duration likely reflects this initial adjustment period. No major perioperative complications were observed. However, the small number of cases does not allow meaningful assessment of any potential association between operative duration and outcomes. Reports describing early institutional experiences similarly highlight the importance of careful preparation and stepwise case progression when introducing robotic surgery into pediatric practice. (3, 4)

Choledochal cyst excision

Choledochal cyst excision requires careful dissection in proximity to major vascular, biliary and pancreatic structures and precise biliary reconstruction. These technical demands make minimally invasive reconstruction challenging, particularly in smaller patients.

In our series, all cyst excisions were completed robotically without conversion or major complication. Comparative analyses have reported perioperative outcomes similar to laparoscopy, with acceptable morbidity profiles in both approaches. Although robotic procedures are associated with increased cost in many settings, reported complication rates and length of stay are comparable between platforms. (5, 9)

A progressive reduction in docking time—from 45 minutes in the first case to 10 minutes in the fourth—reflects early team familiarization and workflow refinement. This trend suggests that efficiency improves with structured repetition and standardized port configuration during the initial phase of the program.

Colorectal and pelvic procedures

Pelvic reconstruction for anorectal malformation requires careful identification of the fistula and controlled dissection within a narrow operative field. Minimally invasive approaches have been

increasingly applied to these procedures, with published series reporting low conversion rates and acceptable early morbidity. (6, 10)

In our cohort, all pelvic dissections were completed robotically without conversion or major complication. The platform provided stable instrument control during fistula division and reconstruction. These characteristics may be particularly relevant in our setting, where delayed referral is common and patients often present with chronic colonic dilation, fecal loading, inflammation, or prior diversion procedures. Such factors can distort pelvic anatomy and increase operative complexity compared with classic textbook cases.

Although long-term functional outcomes require further follow-up, short-term perioperative results in this series were comparable to those described in other pediatric robotic colorectal reports. (6, 10)

Limitations and Context of Implementation in LMIC Setting

This report represents the early experience of a newly established pediatric robotic program at a single institution and reflects the practice of one primary console surgeon. The limited number of cases and short follow-up restrict conclusions regarding long-term functional outcomes, particularly for reconstructive colorectal procedures. Additionally, the absence of a laparoscopic or open comparison group precludes direct assessment of relative operative efficiency or postoperative recovery.

A formal cost analysis was not performed. The economic impact of robotic surgery remains an important consideration in resource-constrained settings, where capital expenditure and consumable costs may influence program sustainability. Comparative analyses in pediatric choledochal cyst surgery have reported similar short-term outcomes between robotic and laparoscopic approaches, though at higher overall procedural cost. (9) In our institution, careful case selection and institutional support were essential to start the program.

Despite these limitations, this series provides early experience from a public tertiary referral center operating in a resource-constrained healthcare setting. Experience from other institutions suggests that careful preparation, team training, and gradual expansion of case complexity can support safe program development. Ongoing follow-up, broader experience, and future cost-effectiveness analyses will be important to better define the role of pediatric robotic surgery in similar LMIC environments.

CONCLUSION

This study presents the first reported pediatric robotic surgery case series from the Philippines and describes the initial experience of a newly established program in a public tertiary referral center. All procedures were completed robotically without major complications, and short-term outcomes were consistent with those reported in other early pediatric series. These findings indicate that pediatric robotic surgery can be introduced in a resource-constrained healthcare setting with careful preparation and appropriate case selection. Ongoing case accrual, longer follow-up, and future cost evaluation will be important to better define its role in pediatric surgical practice within LMIC settings.

Declarations

Ethics approval

This study was approved by the University of the Philippines Manila Research Ethics Board (UPMREB 2025-0806-01). The requirement for individual informed consent was waived due to the retrospective design and use of anonymized data.

Conflict of interest

The author declares that there are declare no competing interests. No financial or non-financial conflicts of interest exist with respect to the conduct, authorship, and publication of this study.

Use of artificial intelligence

Generative artificial intelligence (ChatGPT, OpenAI) was used to assist in language refinement and structural editing of the manuscript. All clinical content, interpretation of data, and final editorial decisions were made solely by the author. The author takes full responsibility for the accuracy and integrity of the content.

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Author Contribution

Jan Miguel C. Deogracias: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

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