Impact Surgery

Original Research Paper

e-ISSN: 2978-1655

Implementation and outcomes of laparoscopic surgery in a COSECSA-accredited teaching hospital in Kigali, Rwanda: Mixed-methods study

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Abstract

Background: Laparoscopic surgery is increasingly adopted in low-resource settings, yet evidence describing its implementation and real-world practice remains limited. This study aimed to describe laparoscopic surgical practice, patient characteristics, and early outcomes at a tertiary teaching hospital in Kigali, Rwanda, while exploring contextual factors influencing service delivery.

Methods: A mixed-methods study was conducted at Kibagabaga Level II Teaching Hospital. The quantitative component included all consecutive patients undergoing laparoscopic surgery during the study period, with demographic, clinical, and procedural data extracted from routine hospital records. The qualitative component consisted of structured discussions with members of the multidisciplinary surgical team to explore workflow, implementation processes, and operational challenges. Quantitative data were analysed descriptively, and qualitative findings were synthesised narratively to provide contextual interpretation.

Results: Consecutive laparoscopic cases were captured, demonstrating the range of procedures performed and the characteristics of patients undergoing minimally invasive surgery in this setting. The analysis described operative indications, procedural distribution, and perioperative outcomes documented in routine clinical practice. Qualitative findings highlighted key organisational and resource-related factors influencing laparoscopic service delivery, including workflow, team coordination, and implementation challenges within the institutional context.

Conclusions: Laparoscopic surgery can be successfully delivered in a tertiary teaching hospital in Rwanda, with practice shaped by both clinical and organisational factors. Combining outcome data with contextual insights provides a more comprehensive understanding of surgical implementation in resource-limited settings and may inform future capacity-building efforts.

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Cite as: Khan A, Shyaka O, Iradukunda H, Joyeuse U, Bucyekabiri I, Dushimimana V, Mukakalisa C, Munyemana E, Mpirimbanyi C. Implementation and outcomes of laparoscopic surgery in a COSECSA-accredited teaching hospital in Kigali, Rwanda: Mixed-methods study. *Impact Surg*, 3(1), 395–400. https://doi.org/10.62463/surgery.310

Introduction

Minimally invasive surgery (MIS), particularly laparoscopic surgery, has transformed surgical care worldwide, and offers clinical advantage over open surgery. Smaller incisions, less postoperative pain, lower infection rates, and faster recovery leading to shorter length of stay (LOS) are clear benefits [1,2]. These advantages are further underscored in low resource settings, such as Rwanda; however, the adoption of laparoscopic surgery is a complex process that relies not only on the operation itself, but also on various other factors that impost greater challenge to implementation. Cost, resource utilization, training, hospital infrastructure, and education are key challenges in many low-and-middle income countries (LMICs) [1–3]. A significant proportion of surgical disease burden that could be managed effectively laparoscopically is often untreated or still managed via conventional open surgery in these settings [3].

In sub-Saharan Africa, many countries are adopting laparoscopy as a standard of care, though overall regional implementation is still in early stages [3,4]. In Rwanda, a study ten years ago observed that only 209 laparoscopic procedures were performed throughout the country, with over half performed at a large private hospital in Kigali [5]. Similarly, a recent large study of multiple COSECSA-affiliated hospitals found that an average of 10 laparoscopic procedures were performed per month at each hospital, with a median of three surgeons per hospital qualified to perform laparoscopy and only two instrument sets available in the hospital [6].

Amongst the many well-documented barriers to the implementation of laparoscopy in LMICs, the cost is often a key cited factor[2,3,6]. The upfront cost of equipment and infrastructure, recurring expenses including gas and disposables, and training can lead to challenges with patient affordability and can strain hospital budgets. While evidence in Rwanda supports this claim, the most critical limitation is often the availability of trained personnel. There are few MIS trained surgeons and even fewer qualified to teach in structured training programs [5,7]. Many programs exist aiming at resolving this shortage, such as ALL-SAFE (African Laparoscopic Learners – Surgical Advancement For Ectopic pregnancy) and the Global Laparoscopic Advancement Program (GLAP) through the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) [8,9]. In addition, COSECSA recently introduced the Certificate in Laparoscopic Surgery (CLS) to formally integrate laparoscopic skills in training programs [10].

In Rwanda, previous studies have focused only on large private or referral hospitals [5,11,12]. Given the continued expansion of laparoscopic surgery in Rwanda, we aim to identify the results of an implementation in a Level Two Teaching Hospital (L2TH), for which published data is lacking. This setting offers an opportunity to identify the experience and impact of implementing a laparoscopic program outside of a referral hospital and provide benchmarks for the first year of implementation. The primary objective in evaluating this is to determine context-specific challenges encountered, patient outcomes, surgeon and staff experiences, and key lessons learned to improve surgical care delivery in Rwanda.

Methods

Study Objectives

The study aimed at assessing the experience, challenges, and outcomes of laparoscopic surgery during its first year at Kibagabaga Level Two Teaching Hospital in Kigali, Rwanda. Findings will be utilized to understand the feasibility of laparoscopic surgery in a Level Two Teaching Hospital to help policymakers, educators, and surgeons enhance surgical services in Rwanda and similar settings.

Study Design and Setting

This study used a mixed-methods design combining quantitative analysis of consecutive laparoscopic surgical cases with qualitative description of clinical practice during the study period. The study was conducted at Kibagabaga Level II Teaching Hospital in Kigali, Rwanda, a tertiary teaching institution providing surgical services to a large urban and peri-urban population and serving as a training centre for multidisciplinary surgical teams including surgeons, nurses, and perioperative staff. Laparoscopic procedures are performed as part of routine clinical care within the general surgical service.

Patient Inclusion Criteria

The quantitative component included all patients who underwent laparoscopic surgery at the institution during the study period. Consecutive sampling was used to ensure comprehensive capture of cases and minimise selection bias. Patients were eligible for inclusion regardless of age, sex, or surgical indication, provided that the procedure was performed using a laparoscopic approach. Cases were excluded if operative or clinical records were incomplete or unavailable for review. No additional clinical exclusions were applied, as the objective was to describe real-world surgical practice.

Data Collection

Patient and procedural data were obtained from routinely maintained hospital records, including operative logs and clinical documentation. Extracted variables included demographic characteristics, surgical indication, type of laparoscopic procedure performed, and perioperative findings and outcomes as documented in the medical record. Data collection reflected standard clinical care and did not involve modification of management or intervention by the study team.

Qualitative Component

To complement the quantitative findings, a qualitative descriptive component was undertaken to provide contextual understanding of laparoscopic surgical practice. This involved structured discussions among members of the clinical team directly involved in laparoscopic care, including surgeons and nursing staff. These discussions explored workflow, implementation processes, team dynamics, resource considerations, and operational challenges encountered during the study period. The qualitative component was intended to capture organisational and experiential factors influencing surgical practice that were not reflected in the clinical dataset.

Ethical Considerations

The research was approved by research and ethical committee of the hospital. No external ethical review was deemed required by the hospital ethical committee. No physical, social, emotional, legal, and/or financial risks were identified as a risk to subjects, and informed consent was obtained from each participant in the focus group discussions. Consent was waived for retrospective chart data due to minimal risk and the use of de-identified data. Each participant was assigned a unique study identifier number. A password-protected linking study ID and personal identifier (name, hospital ID) were kept separately by the principal investigator (PI). Only the researcher and the research team had access to the study data and information.

Results

Patient Characteristics

Over a 12-month period, 162 patients underwent laparoscopic surgery. Patient age ranged from 16 to 89 years, with a mean age of 48 years. The majority of patients were female (128, 79.0%; Table 1). Most individuals were classified as ASA class I (84%) and had no documented comorbidities.

Table 1: Patient demographics (n = 162)

Category	Variable	n (%)
Age (years)	16-34	31(19.1)
	35-59	89 (55.0)
	≥ 60	42 (25.9)
Sex	Female	128 (79.0)
	Male	34 (21.0)
Origin	Outside Kigali	90 (55.6)
	Kigali	72 (44.4)

Preoperative assessment and surgical indications

Preoperative ultrasound was performed in 76% of cases. The most common diagnosis was symptomatic cholelithiasis, accounting for 80.2% of surgical indications (Table 2).

Table 2: Preoperative clinical characteristics and management (n = 162)

Category	Variable	n (%)
ASA classification	I	136 (84.0)
	II	24 (14.8)
	III	2 (1.2)
Comorbidities	None	136 (84.0)
	Hypertension	19 (11.7)
	Diabetes Mellitus	5 (3.1)
	HIV	2 (1.2)
Preoperative imaging	Ultrasound	123 (76.0)
	CT Scan	23 (14.2)
	Ultrasound and CT scan	16 (9.8)
Diagnosis	Symptomatic cholelithiasis	130 (80.2)
	Acute appendicitis	21 (13.0)
	Acalculous cholecystitis	4 (2.5)
	Abdominal Mass	4 (2.5)
	Bowel Obstruction	3 (1.8)

Operative Procedures and Intraoperative Outcomes

Cholecystectomy was the most frequently performed procedure, representing 83% of all operations. Most procedures were completed without intraoperative events (98.2%). Two cases required conversion to open surgery (Table 3).

Table 3: Intraoperative characteristics (n = 162)

Category	Variable	n (%)
Type of operation performed	Cholecystectomy	134 (83.0)
	Appendicectomy	21 (13.0)
	Diagnostic laparoscopy and band release	3 (2.0)
	Diagnostic laparoscopy and biopsy	2 (1.0)
	Mass excision	2 (1.0)
Intraoperative findings	None	160 (98.8)
	Conversion to open	2 (1.2)
Preoperative imaging	Ultrasound	123 (76.0)
	CT Scan	23 (14.2)
	Ultrasound and CT scan	16 (9.8)
Reasons for conversion (n = 2)	Difficulty identifying critical structures	1 (50.0)
	Bleeding	1 (50.0)

Postoperative outcomes

Postoperative complications were identified in 3% of patients. The 30-day readmission rate was 1.2%, and the median length of hospital stay was 2 days (Table 4).

Table 4: Postoperative outcomes (n=162)

Category	Variable	n (%) or value
Postoperative complications	None	157 (97.0)
	Surgical site infection	3 (1.8)
	Unplanned reoperation (intra-abdominal abscess following appendicectomy)	1 (0.6)
	Biliary injury (referred for ERCP and stenting)	1 (0.6)
Readmission within 30 days	Yes	2 (1.2)
	No	160 (98.8)
Length of hospital stay (days)	Median (IQR)	2 (2–3)

Qualitative findings

Group discussion results were categorised into themes and subthemes. The focus groups included perioperative nurses (n=4), surgeons (n=1), a general practitioner (n=1), an intern (n=1), anaesthesia providers (n=2), and administrative personnel (n=5) (Table 5).

Discussion

In the first year of implementation in Kibagabaga L2TH in Rwanda, a COSECSA-affiliated institution, 162 patients underwent laparoscopic general surgical procedures. There was a predominance of women, which correlates with prior laparoscopic studies [3], and early clinical outcomes were favorable, with 97% of patients have no postoperative complications and only 2 cases converted to open. We also observed short hospital LOS, with a median of 2 days. Qualitative data from surgical team interviews emphasized that there was a perceived advantage to laparoscopic surgery over conventional open surgery, with a perception of better patient experience as well.

Given this was the first year of implementation, the predominant procedures performed were cases with well documented laparoscopic benefit– 96% of all cases were cholecystectomies or appendectomies, though as the year progressed there was an expansion into more complex cases, such as band release and mass excisions. The team adapted quickly despite known resource limitations (for instance, only using monopolar L-hooks for electrocautery). Through a collaboration with the Global Surgery Hub through the University of Rwanda, the team was able to participate in simulations and a dry lab [13]. The participation in different IRCAD Africa training courses (laparoscopic general surgery intensive course and laparoscopic trauma surgery for general surgeons: advanced course) enhanced the surgeon skills. This likely accelerated the skills acquisition and understanding of the team as other studies have reported, though further study is needed in Rwanda to characterize this [14]. While training gaps were noted by members of the clinical team, the majority of the comments in the focus group regarding training indicated that the implementation of the training program at Kibagababa hospital was

Table 5: Focus group discussion findings

Theme	Representative quotations
Perceived clinical benefit (recovery, surgical site infection, length of stay, outcomes)	"Patients recover quickly and experience less pain." "Less risk of infection and smaller incisions." "Short hospital stay." "Chronic inflammation led to dissection difficulties and prolonged operative time."
Case mix and scope (most common cases)	"Cholecystectomy was the most performed procedure."
Equipment constraints (missing equipment, energy devices)	"We only used a monopolar L-hook." "Inappropriate operating room table." "Limited access to advanced energy devices."
Training and capacity (limited opportunity, gaps in knowledge)	"There was no training and I delayed adapting myself in the past." "Shortage of surgeons, nurses, and anaesthetists trained in laparoscopy."
Overall satisfaction and expectations (patient and provider experiences)	"Outcomes were better than expected and caretakers were appreciative."

helpful in developing the basics of understanding laparoscopic equipment and technique.

The findings in this study align with previous studies in Rwanda, predominantly at tertiary referral centers. A 2014-2015 assessment noted sparse laparoscopy utilization with limited training resources, which remains to be a similar theme today as noted by our focus groups; for many, this was their first exposure to laparoscopy [5]. Subsequent studies in Rwanda noted higher patient satisfaction with laparoscopy, low complication rates, and shorter hospital stays, the latter two demonstrated by this series (patient satisfaction was not directly evaluated in our study) [11,12]. The female-predominant cohort in this study is also similar to prior laparoscopic studies in multi-country reviews amongst other LMICs, largely because gallstone disease was our most common pathology and is seen more in females than males [3]. Throughout the COSECSA region, challenges with cost, training, and limited instruments are often noted to be barriers to implementation, and our team acknowledged that training and instrument availability were also previous barriers prior to this inaugural implementation of laparoscopy [4,7,15,16].

Our study reveals that the implementation of laparoscopy at smaller hospitals in Rwanda, either L2TH or district hospitals, is possible through a thoughtful, systematic model. Beginning with higher volume and low complexity cases, implementing a standardized training and simulation program for all staff (surgeons, nurses, anesthetists), and ensuring standardization of equipment trays was demonstrated to be successful in our facility. However, policy on a broader national scale will require additional considerations, such as protected training time and mentorship, reliable supply chain for consumable equipment, and financial coverage via insurance programs to ensure more widespread uptake of laparoscopy. Regionally validated training programs, such as through the Global. Surgery Hub in Rwanda, ALL-SAFE, GLAP, or the COSECSA certificate in laparoscopic surgery can help formalize competencies and provide structure to new programs. Future research should include multiple centers, both district hospitals and L2TH, to compare clinical outcomes, volumes, costs, and opportunities for future growth. Additionally, financial impact of laparoscopy was not evaluated in this study, but has been evaluated in Rwanda already[12]. Further review of this in additional studies could help inform government policy on national health insurance coverage in Rwanda.

A primary strength of this study is its mixed-methods approach to include clinical metrics such as outcomes as well as qualitative team discussions. We also captured all laparoscopic cases for a full year, following a targeted training to all involved operating theatre staff. Limitations exist given the nature of retrospective data collection, such as potential information bias during data abstraction from charts and possibly missed data on follow-ups (particularly if a patient was seen at a different institution). Generalizability in this study is also constrained given one trained surgeon at our facility. We also did not perform a

specific cost-benefit analysis, and this should be included in future studies, particularly with the goals of scaling up laparoscopy in Rwanda or other COSECSA-affiliated countries. Lastly, only general surgical laparoscopic procedures were performed in this setting, thus generalizations cannot be extrapolated to other specialties or more complex cases given the predominant case types in this study.

Laparoscopy remains a key area of potential growth in Rwanda and other LMIC's. Our study demonstrated the feasibility of implementing laparoscopy in a smaller teaching hospital instead of larger tertiary referral centers. Our findings correlate with previous studies on the benefits of laparoscopy in this setting: shorter hospital length of stay, lower complication rates, and faster patient recovery. The value of the training program implemented in our study through the Global Surgery Hub at the University of Rwanda was also noted to be a key factor in our focus group discussions with the surgical team. The success of our training model could be developed into a structured national model that could aid in the expansion of laparoscopy in Rwanda or be including in minimally invasive surgical training for residents. Ultimately, further studies should evaluate the reproducibility of our success in a multi-center cohort to strengthen the health system in similar settings and invest in technologies with proven benefit to patient outcomes. The development of a standardized training model or curriculum for surgeons could be valuable in Rwanda and in alignment with national goals; given this study demonstrates the feasibility in a level two teaching hospital, continued expansion to other hospitals should be evaluated.

Conflicts of Interest: None declared.

Funding Statement: No funding has been sought or gained for this project

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