
Feasibility of Laparoscopic Surgery in a Resource Limited Setting: Cost Containment, Skills Transfer and Outcomes

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Background: Where as the first Laparoscopic cholecystectomy was performed more than three decades ago in Europe. In Uganda interventional laparoscopic procedures like cholecystectomy and appendicectomy commenced only recently. This paper in three parts describes the first 178 procedures done at a hospital in Kampala, a cost saving technique for Laparoscopic appendicectomy as well as highlighting a practical skills transfer model.

Method: Multiple designs; a descriptive retrospective design for part one, a prospective single cohort for part two and a qualitative description for part three. The data was collected from the operating room logs operative notes and follow-up visits notes for the first part. For the second part a prospective single cohort design, every consecutive patient who presented with features of acute appendicitis and consented was included in the study. A low cost extra corporeal appendiceal stump ligation technique is described. For part three, the notes, materials and schedules used for skills transfer session were reviewed. Sata was manually analysed using a spreadsheet. Institutional Review Board (IRB) approval was secured.

Results: Of the 178 procedures 64 (36%) were appendicectomy, 30 (17%) were cholecystectomy and 75 (42%) were diagnostic. Male: Female ratio was 1:3. Major complications occurred in 1.7% of the study group. Two appendicectomy and two cholecystectomy were converted. A cost containment extracorporeal ligation technique for appendiceal stump ligation was performed for 50 appendicectomy with no wound sepsis recorded, in the follow up period.

Conclusion: The complication rates were comparable to work done elsewhere. The appendicectomy extracorporeal technique was safe and low cost. Short but repetitive hands-on training sessions are appropriate for training qualified surgeons on site. Interventimal Laparoscopic surgery is feasible in resource limited settings.

Introduction

Whereas the first Laparoscopic cholecystectomy was performed more than three decades ago (1987) in Europe and the practice caught on for even other surgeries¹. It is only recently arrived in Uganda. However the first diagnostic laparoscopic cases were done in mid nineties. A decade later enough interest and modest resources had been mobilized. Whereas the general thinking may be that keyhole surgery is expensive and impractical for developing country low resource settings there are counter arguments, the benefits of short stay, reduced morbidity and good cosmetic outcomes^{2,3,4} would still hold for patients in the developing world. Keyhole surgery would mitigate the trauma of negative Laparotomy and provide accurate information for staging in oncological conditions like gastric cancer.

The challenges encountered include; the costs for set up, consumables, which include trocars, cannulae, maintenance of equipment and troubleshooting in case of equipment failure. Reliance on the biomedical technician(s) component is heavy especially in areas of unreliable power supply. The other challenge is securing training without leaving ones workstation (on site).

This article describes the outcomes at operations done two general surgeons and a gynaecologist; a skills transfer process and a cost containment technique for appendicectomy.

Patients and Methods

For one part it was a descriptive retrospective design. The data was collected from the operating room logs, operations and patients' follow up visit notes. Data was manually analyzed using a spreadsheet. The second part of this study took on a single prospective cohort design. Every consecutive patient that presented with and confirmed to have a diagnosis of acute appendicitis. A low cost extra corporeal appendiceal stump ligation technique was performed by a single surgeon and the patients followed up for a period of 6 week period, in the surgical outpatient clinic. The outcomes were assessed using standard history taking, clinical examination inclusive of checking for a purulent wound discharge and requesting for investigations relevant to wound infection. The study was approved by the Research ethics committee.

Description of the proposed low cost appendiceal technique ligation

This method is thought to work best in the leaner patients with abdominal wall fat layer less than 3-4cm (2'), and in non-perforated appendices. The routine protocol is followed; clear indication, patient consent and skin preparation with (10% iodine and 70% alcohol). The patient is placed in the supine position with the arms tucked at the sides and securely strapped to allow for the subsequent changes in operating table positions. General anaesthesia is induced, a nasogastric tube inserted (optional) and foley catheter (essential) placed. Rationale for this was not only to prevent injury to the stomach and bladder but also allow for adequate exposure (operating space).

A Pneumoperitoneum with Carbon dioxide was created via a 16' verses needle with intra-abdominal pressure, up to 15mmHg, as the maximum. The initial trocar was placed at the umbilicus; the camera port site. An initial diagnostic or exploratory laparoscopy is then performed. Additional trocar placements are then done under direct vision. Two 5mm trocar and cannulae, for retraction and dissection are at suprapubic mid point and at Mcburney's point respectively. After dissection and cautery of the mesoappendix and achieving haemostasis. The appendix tip is grasped by a serrated grasper and delivered via the port wound (at Mcburney's point). Just as the appendix tips get through the cannula, the cannula is withdrawn to expose the appendix delivered in the port wound. Gentle traction while observing on the monitor is applied until the base of the appendix abuts the anterior abdomen wall peritoneum. At that point haemostats (artery forceps) are used to crush the appendiceal base before dividing and doubly ligating with vicryl 3/0 as done in a routine open appendicectomy. All fascial incisions greater than 5mm are closed and appropriate skin closure is performed and the patient is transferred to the recovery room. The appendiceal stump is left everted.

Skills transfer model

Three general surgeons and two obstetricians including the authors were trained in the country (onsite) , this happened in four sets of -two week intense hands-on courses. The training sessions were four to six months apart by visiting experienced surgeons from overseas. The two week courses were structured in three parts. Part one was composed of three didactic sessions were two facilitators using PowerPoint presentations and DVDs covered the history /evolution of minimal invasive surgery, indications, the operative procedures step by step, complications and their management as well as equipment failure and consumables and appliances. The second part was by simulation using dummy trainers run for several hours for each trainee with one on one supervision and immediate feedback. The third part was 7 days in the operating round one on one with the trainer.

Results

Outcomes

All procedures were done successfully and the post immediate operative periods were uneventful, save for three: One patient a 39 year old female with cholelithiasis/cholecystitis and recurrent appendicitis had a cholecystectomy and appendicectomy done at the same sitting. She sustained a Common Bile Duct (CBD) injury type D, eventually had a choledochorraphy on the 4th postoperative day. She developed a CBD stricture 7 months later for which an ERCP examination failed and a choledochojejunostomy was done successfully, 10 months later she was well and her quality of life are was satisfactory.

Table 1. Summary of cases done

Sex ratio M:F	1:3
Mean age	32 years
Age Range	4 – 75 years
Appendicectomy	64
Diagnostics (e.g. infertility, Intra abdominal malignancy)	75
Cholecystectomy	30
Cystectomy (chronic pelvic pain)	5
Salpingolysis (for infertility)	3
Tubal ligation	2
Conversions rate (Bladder and appendix)	4.2%
Major complications rate (3 of 178)	1.7%
Total	178

Two patients cholecystectomy had the procedure converted to laparotomy on the account of unsatisfactory haemostasis in the gall bladder bed despite use of cautery.

Two patients with appendectomies converted one had an appendicular abscess and the other though presented with features of appendicitis had no appendix, it was removed during prior surgery but the patient did not recall it, eventual diagnosis was a terminal ileitis. The standard procedure for ligating the appendiceal stump would require two

endoloops (prettied endosutures) vicryl 0 sutures each costs 100 USD at retail price. Two would cost close to 200 USD. An ordinary Vicryl 3/0 suture costs 8 USD locally. This technique would save 192 USD per patient. After the second set of skills transfer exercise the trainees were able to independently perform diagnostics procedures comfortably and safely. After the third and second set of the skills transfer exercise the trainees would now perform the rest of the other procedures as indicate in the table of outcomes.

Discussion

Diagnostic laparoscopic procedures, appendicectomy and cholecystectomy are less technically demanding as compared to procedures such as Nissen's fundoplication, splenectomy and colectomy. Starting with the prior mentioned category of procedures was a prudent starting platform to train in safe cannulation, ligation, dissection and clipping. The sex ratio in females is due to diagnostics for infertility procedures. The leading cause of infertility in Uganda is tubal blockage due to infections.

The appendiceal ligation procedure described here is cost saving. The other cheaper options that could make keyhole surgery less expensive including metallic reusable trocar and cannulae instead of the single use disposables ones. Self made loops with a sliding knot is another cost containment option. Other Appendiceal Removal options include; endoscopic linear staplers, clip applicators with cautery on mesentery, prettied loop ligatures (an appendix), self made endoloops with sliding knot and Pelosi's method as described later in the text. Laparoscopically, the appendix should be placed in a specimen bag prior to its removal. In this way, the inflamed appendix never touches the skin or subcutaneous tissues resulting in a very low infection rate. In these series the bag was not used, the appendix touched the skin and subcutaneous tissue the infection rate was zero out of fifty cases. Possibly then the appendix touching is not such a risk factor.

Laparoscopic manipulations require precise eye hand coordination, with awkwardly long and narrow instruments. Retraction is unlike the one surgeons are used too. Simple knotting is not simple, needs to be learnt a new. These mentioned factors and more predispose to an increased probability of complications such as bleeding, cautery and bile duct injuries^{5,6}. Hands on training and under supervision is therefore critical In the technique explored in this paper, like Pelosi's the knotting is extracorporeal and done in the usual manner the operator is likely to be used to.

Another technique for removing the appendix has been described using only one 10mm trocar. Pelosi describes using a 10mm laparoscope with a 5mm operating channel within it¹³. The appendix is visualized and any adhesiolysis required is performed using bipolar coagulation forceps. The appendix once mobilized is then grasped with an atraumatic forceps. The trocar is removed de sufflating the abdomen and the appendix is delivered through the umbilical trocar site. The appendix is then divided in a standard open fashion. Care must be exercised to avoid too much tension on the appendix while bringing it up through the umbilicus.

The question has been raised before whether we can justify the performance of such operations by those attending short courses in laparoscopic training. There is a need for credentialing and granting of privilege to surgeons desirous of entering the laparoscopic arena⁷. The challenges to consider in settings such as Uganda, the resources to commit to long-term training are unavailable; the number of health workers are so few⁸ that the administrators are reluctant to have some off for long periods of study. Therefore training on site is ideal, it does not take anyone away. The training happens in the context in which the actual practice takes place. However, this does not solve the funding issue funds needs to be found to have the more experienced surgeons, mostly from industrialized wealthier nations (more developed countries) come to the resource constrained environments to train as volunteers. Cost of consumables could be another down factor for development of laparoscopy in the developing world. Ways of cost cutting but maintaining safety and efficiency ought to be continually sought.

For the other procedures in Table 1, the postoperative periods were uneventful with no complications in the follow up period of up to six weeks. Complications looked for where signs of intra abdominal and wound sepsis.

Laparoscopic appendectomy unlike other laparoscopic procedures may not have gained much universal acceptance among general surgeons, but it is a useful addition to the options, especially in patients with right lower quadrant pain of uncertain etiology as in women or reproductive age, the elderly and the obese in whom one is not certain of the diagnosis. A selective approach to laparoscopic appendectomy has been recommended before a selective approach to what resources to use is one of the recommendation this article puts forth.

Conclusion

Laparoscopic surgery is appropriate for developing countries, the proven benefits apply in these environment. Short repeated well supervised hands on training courses is a workable skills transfer strategy for training qualified surgeons in practice and without leaving their workstations. Cost containment but safe techniques need to be continually looked for to tackle the sustainability issue in low resourced countries.

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References

1. Fitzgibons RJ, Salerno GM. Historical Review: Diagnostic Laparoscopy to Laparoscopic cholecystectomy and beyond. In Zucker KA, Bailey RW, editors. Surgical Laparoscopy. Quality Publishing, St Louis. 1991:41-6.2.
2. Grace P, Quereshi A, Darzi A, McEntee G, Leahy A, Osborne H, et al. Laparoscopic cholecystectomy: a hundred consecutive cases. Ir Med J. 1991; 84:17-14.3.

3. Rutherford J, Stowasser M, Tunny T, Klemm S, Gordon R. Laparoscopic adrenalectomy. *World J Surgery*. 1996; 20: 758-761.4.
4. Gagner M, Pomp A, Heniford BT, Pharand D, Lacroix A. Laparoscopic adrenalectomy: Lesions learned from 100 consecutive procedures. *Ann Surg*. 1997; 226:238-246.5.
5. Rezmick RK, Macrae H. teaching surgical skills – changes in the wind. *N Engl J Med* 2006; 355; 25: 2664-96.
6. Halm EA, Lee C, Chassin MR. Is volume rated to outcome in health care? A systematic review and methodologic critique of the literature. *An Intern Med* 2002; 137: 511-207.
7. Gurusamy K, Aggarwal R, Palanively L, Davidson BR. Systematic review of randomised controlled trials on the effectiveness of virtual reality training for laparoscopic surgery. *British Journal of Surgery* 95: 1088-1097. doi 10.1002/bjs.63448.
8. Singh Y. Training and Credentialing in Laparoscopic surgery-the need of the day. *MJAFI*. 2005; 61:7-8.9.
9. Adams DB, Barowicz MR, Wootton FT, Cunningham JT. Bile duct complications after Laparoscopic Cholecystectomy. *Surg endosc*. 1993; 7:79-83.10.
10. Munday D, Kerin J. A Laparoscopic surgical training and accreditation program up and running. *Aust N Z J Obstet Gynaecol*. 1999; 39(4):430-7.11.
11. Ozgediz D, Galukande M, Mabweijano J, Kijjambu S, Mijumbi C, Dubowitz G, Kaggwa S, Luboga S. The neglect of Global Workforce: Experience and Evidence from Uganda. *World Journal of Surgery*. DOI 10.1007/s00268-008-9473-412.
12. Pelosi M. Laparoscopic appendectomy using a single umbilical puncture (Mini laparoscopy). *J Reprod Med*. 1992; 37: 588-594.13.
13. Zucker KA. *Surgical Laparoscopy 2nd Edition* 2001. lippincott Williams & Willins14.
14. Fallalizadeh. Should a Laparoscopic appendectomy be done? *Am surg*. 1998; 64: 231-233.15.
15. Mine L, Varnen D, Burnell A et al. Laparoscopic versus open appendectomy: prospective randomised study of outcomes. *Arch surg*. 1997; 132: 708-712.16.
16. William M, Collin J, Wright T et al. Laparoscopic versus open appendectomy. *South Med J*. 1996; 89:668-674