Laparoscopic hybrid pyloromyotomy for infantile hypertrophic pyloric stenosis: A simplified technique

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Abstract

Introduction: Laparoscopic pyloromyotomy (LP) for the treatment of infantile hypertrophic pyloric has advantage of smaller incisions, faster recovery, reduction in wound-related complications and better cosmesis. Various laparoscopic knives and spreaders have been used for LP, but they do not provide the depth and tissue perception as in open surgery. We describe the laparoscopic hybrid pyloromyotomy (LHP) which makes procedure simple and safe without the requirement of any special instrument.

Materials and Methods: This retrospective and prospective comparative study was conducted over a period of 4.5 years in a tertiary teaching hospital in central India. All patients with infantile hypertrophic pyloric stenosis diagnosed on the basis of clinical history, examination and ultrasonography were included in the study. Retrospective data of three-port conventional LP (CLP) using monopolar diathermy hook for incision was used as control group against prospective data of 25 patients undergoing LHP. After a proper layout, LHP was done using one umbilical optical port, right paraumbilical grasper of holding the pyloric olive and an epigastric incision for hybrid pyloromyotomy using 11 no blade and blunt-tipped mosquito artery forceps.

Results: Prospective group of LHP included 25 patients which were compared with a retrospective group of CLP consisting of 25 patients. On comparison of two groups, it was found that LHP reduces operative duration significantly. The outcome in terms of complications and recovery was comparable in two groups. None of the patients developed recurrence and required any redo surgery.

Conclusion: LHP is a simplified approach which is easy to learn and teach, improves safety and accuracy of the procedure.

Keywords: Hybrid, laparoscopy, pyloromyotomy

INTRODUCTION

Laparoscopic pyloromyotomy (LP) has become a preferred approach for the treatment of infantile hypertrophic pyloric stenosis in infants.¹ The advantages of LP include smaller incisions, faster recovery, reduction in wound-related complications and better cosmesis.² In the laparoscopic approach, the inadequacy of pyloromyotomy and mucosal have been attributed to lesser tissue perception with laparoscopic instruments.³ To replicate laparoscopic with open technique in terms

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of results, various laparoscopic knives and spreaders have been used.\footnote{4} We describe the laparoscopic hybrid pyloromyotomy (LHP) which allows better tissue perception leading to replication of open procedure in terms of simplicity, safety and adequacy.

**MATERIALS AND METHODS**

This retrospective and prospective comparative study was conducted from July 2013 to December 2018. Patients with infantile hypertrophic pyloric stenosis diagnosed on the basis of clinical history, examination and ultrasonography were included in the study. Patients with aspiration pneumonia were considered unfit for pneumoperitoneum and were excluded. From July 2013 to December 2015, 25 patients who underwent conventional LP (CLP) using three ports and using monopolar cautery hook for incision were used as a control group. From January 2016 to December 2018, all patients underwent LHP. The LHP group was compared with CLP group in terms of epidemiological characteristics, pyloric wall length and thickness on ultrasound, operative duration (measured from incision to closure), complications and measurement of outcome in terms of resumption to full feeds and hospital stay. CLP was done with the standard technique, which is described in literature using monopolar cautery hook. LHP was done as follows: under general anaesthesia, the patient was placed in supine frog-leg position across the width of the table with surgeon and cameraman standing at head-end and monitor at the foot-end of the patient. A 5-mm port was introduced in the umbilical fold by open technique to introduce 5-mm 30° telescope. Pneumoperitoneum was established at a maximum pressure of 6–8 mmHg at the rate of 1 L/min. A 3 mmatraumatic grasper is placed in the right paraumbilical region by stab technique to hold the pyloric olive which was manipulated toward the anterior abdominal wall on the left of the falciform ligament [Figure 1]. An 11 number blade held in handle which is used for open surgery was inserted through epigastric region just above the position of pyloric olive [Figure 2a]. A superficial seromuscular linear incision was made along the superior edge of hypertrophied pyloric musculature safeguarding prepyloric vein and manipulation of olive under the blade aids in making incision [Figure 2b]. The blade was taken out, and a Halsted-Thomson mosquito artery forceps was introduced through the same stab incision, and pyloric spreading is performed [Figure 3a]. Completion of pyloromyotomy was confirmed by ballooning of the intact mucosa and two independently moving pyloric edges [Figure 3b]. The laparoscopy steps of technique are shown in the video submitted as supporting file [Video 1]. The absence of mucosal perforation was checked by insufflation of air through the nasogastric tube if needed. Port sites are closed. Measured feeds were initiated 8 h after surgery, paracetamol suppository was administered 8 hourly for pain relief, and patients were discharged once three consecutive full feeds were accepted. The LHP group was compared with CLP group using standard statistical tests on Medcalc® online software in terms of epidemiology, ultrasound findings, operative duration, resumption to full feeds, hospital stay and complications (mucosal perforation, wound infection, incisional hernia and recurrence).

**RESULTS**

This retrospective and prospective comparative study was conducted from July 2013 to December 2018. For comparison, 25 patients who underwent CLP were included from retrospective records, while prospective 25 patients underwent LHP. The comparison of the
two groups is shown in Table 1. The epidemiological comparison of two groups showed that two groups were similar in epidemiological and clinical characteristics such as age, weight, gender, mean pyloric length and thickness. The mean operative duration was significantly less in LHP group (21 + 7 min) as compared to CLP group (38 + 10 min), \( P < 0.05 \) was considered as statistically significant. Mucosal perforation was found in 2 (0.08%) patients in CLP group as compared to 1 (0.04%) patient in LHP group, statistically insignificant. In LHP group, one patient required conversion to standard three-port pyloromyotomy due to mucosal perforation which was our 3\(^{rd} \) case and was repaired with omentopexy. Recurrence was found in 1 (0.04%) patient in CLP group as compared to none in LHP group, which was statistically insignificant. Two patients (0.04%) developed umbilical incisional hernia in CLP group as compared to 1 (0.04%) patient in LHP group, which was statistically insignificant. The time of resumption to full feed and hospital stay was similar in two groups.

**DISCUSSION**

Ramstedt's pyloromyotomy, described in 1912, has remained the gold standard for the treatment of IHPS over the past century.\(^{[3]} \) Three-port LP was first reported by Alain in 20 infants in 1991.\(^{[4]} \) Three-port LP is associated with less pain, less wound complications, early recovery and better cosmesis, and the complication rate is comparable with open pyloromyotomy.\(^{[1,2]} \) LP has 4% higher rate of incomplete pyloromyotomy and mucosal injury ranging up to 1.67%,\(^{[7,8]} \) To overcome incomplete pyloromyotomy and mucosal perforation, various laparoscopic knives such as arthroty knife, beaver knife, monopolar cautery hook and spreaders have been used in LP. These instruments are not freely available and are associated with lack of depth perception, bleeding obscuring the vision and mucosal perforation.\(^{[9,10]} \) To overcome bleeding, few authors have used monopolar diathermy hook, laparoscopic electrosurgical blade or 18G needle.\(^{[11,12]} \) The results in terms of safety and completion of pyloromyotomy using various instruments for pyloric incision and spreading are variable, and none have been found superior to another in terms of complications while holding the Level-1 evidence.\(^{[3,11]} \) The whole of the debate regarding the use of various modalities for making incision and spreading focus on feasibility and simplicity. Ploeg et al. have emphasised two key points namely parallel-mobility testing and perforation testing in LP to achieve quality control.\(^{[13]} \) The conundrum in LP involves either the fear of mucosal perforation leading to inadequate pyloromyotomy or an overzealous separation leading to mucosal perforation. The use of 'hybrid' approach involves the use of laparoscopy along with 'co-operative' approach of open surgery. This approach has been used commonly during the process of learning paediatric laparoscopy.\(^{[13-15]} \) The hybrid approaches enhance dexterity, simplifies operation, reduce duration and ease the learning curve. The technical dexterity required to perform LP is greater than for its open counterpart. Additional skills need to be acquired after a minimum of 45 procedures, thus leading to the concept of 'the tail end of the learning curve' for the surgical team.\(^{[14]} \) Vegunta et al. reported that the complications occurred primarily with the first 60 procedures.\(^{[17]} \) Thus, surgical teaching using simulators for residents/younger consultants is highly advisable, and it could in fact be deemed to be crucial for safe performance of LP.\(^{[18]} \) The application of hybrid surgery in LHP allows emulation of open pyloromyotomy using open surgery knife for incision and mosquito artery forceps for spreading which allows better depth perception, feel of tissue and accuracy; hence, it is easy to learn and teach. In the present study, it is evident that due to its simplicity, the LHP reduces operative duration significantly. Anwar et al. used similar approach as LHP where they used ophthalmic knife and pyloric spreader. Due to larger size of pyloric spreader, the epigastric incision has to be larger and allows escape of pneumoperitoneum for which they use cumbersome purse-string suture.\(^{[19]} \) LHP uses 11 no blade which is narrower thus avoiding a larger incision and its disadvantages. To avoid larger skin incision due to the blade, authors would like to emphasise that 11 no blade should be used carefully only to give a superficial seromuscular incision, and manipulation of olive is done under it to aid the incision, while rest of the pyloromyotomy is completed by spreading. This avoids extension of skin incision and a safe pyloromyotomy. The learning curve of LHP is easy as one can learn the operation with very few attempts. This

| Criteria                          | CLP, n (%) | LHP, n (%) | \( P \)  |
|-----------------------------------|------------|------------|---------|
| Age (days)                        | 52±7       | 50±10      | 0.4167  |
| Weight (kg)                       | 2.3±0.9    | 2.7±1      | 0.1437  |
| Male/female                       | 19:6       | 18:7       | 1       |
| Mean pyloric length (mm)          | 21±5       | 20±5       | 0.4829  |
| Mean pyloric thickness (mm)       | 8.7±1.6    | 9±1.1      | 0.4400  |
| Mean operative duration (min)     | 38±10      | 21±7       | <0.0001 |
| Time to full feeds (h)            | 24±7       | 23±9       | 0.6630  |
| Length of stay (days)             | 2±1        | 2±1        | 1       |
| Wound infection                   | 1 (0.04)   | 1 (0.04)   | 1       |
| Mucosal perforation               | 2 (0.08)   | 1 (0.04)   | 1       |
| Incisional hernia                 | 2 (0.08)   | 1 (0.04)   | 1       |
| Inadequate pyloromyotomy          | 1 (0.04)   | 0          | 1       |
| Conversion to open                | 0          | 0          | -       |

CLP: Conventional laparoscopic pyloromyotomy, LHP: Laparoscopic hybrid pyloromyotomy
technical modification provides an advantage in terms of its simplicity and reduced operative duration. The advantages in terms of avoiding mucosal perforation and recurrence cannot be established due to small sample size and may require further studies.

**CONCLUSION**

LHP is a simplified approach which combines the advantages of both laparoscopic and open surgery. It is easy to learn and teach, improves safety and accuracy of the procedure.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Jia WQ, Tian JH, Yang KH, Ma B, Liu YL, Zhang P, et al. Open versus laparoscopic pyloromyotomy for pyloric stenosis: A meta-analysis of randomized controlled trials. Eur J Pediatr Surg 2011;21:77-81.
2. St. Peter SD, Acher CW, Shah SR, Sharp SW, Ostlie DJ. Parental and volunteer perception of pyloromyotomy scars: Comparing laparoscopic, open, and nonsurgical volunteers. J Laparoendosc Adv Surg Tech A 2016;26:305-8.
3. Jain V, Choudhury SR, Chadha R, Puri A, Naga AS. Laparoscopic pyloromyotomy: Is a knife really necessary? World J Pediatr 2012;8:57-60.
4. Ploeg M, Keyzer-Dekker CM, Sloots CE, van de Ven CP, Mecussen C, Wijnen RM, et al. Implementation of a quality control system for laparoscopic pyloromyotomy in hypertrophic pyloric stenosis: Hurdles and pitfalls. Eur J Pediatr Surg 2018. doi: 10.1055/s-0038-1667039. [Epub ahead of print].
5. Ramstedt C. Zur operation der angeborenen pylorus stenose. Med Klin 1912;26:1191-2.
6. Alain JL, Grousseau D, Terrier G. Extramucosal pyloromyotomy by laparoscopy. Surg Endosc 1991;5:174-5.
7. Sathya C, Wayne C, Gotsch A, Vincent J, Sullivan KJ, Nasr A. Laparoscopic versus open pyloromyotomy in infants: A systematic review and meta-analysis. Pediatr Surg Int 2017;33:325-33.
8. Royal RE, Linz DN, Gruppo DL, Ziegler MM. Repair of mucosal perforation during pyloromyotomy: Surgeon's choice. J Pediatr Surg 1995;30:1430-2.
9. Muensterer OJ, Adibe OO, Harmon CM, Chong A, Hansen EN, Bartle D, et al. Single-incision laparoscopic pyloromyotomy: Initial experience. Surg Endosc 2010;24:1589-93.
10. Muensterer OJ. Single-incision pediatric endosurgical (SIPES) versus conventional laparoscopic pyloromyotomy: A single-surgeon experience. J Gastrointest Surg 2010;14:965-8.
11. Thomas PG, Sharp NE, St. Peter SD. Laparoscopic pyloromyotomy: Comparing the arthrotomy knife to the bovie blade. J Surg Res 2014;190:251-2.
12. Bataineh ZA, Novotny NM. A novel nonelectrosurgical technique for incising the pylorus in laparoscopic pyloromyotomy. J Laparoendosc Adv Surg Tech A 2018;28:235-6.
13. Perea L, Peranteau WH, Laje P. Transumbilical extracorporeal laparoscopic-assisted appendectomy. J Pediatr Surg 2018;53:256-9.
14. van de Ven TJ, Sloots CE, Wijnen MH, Rassouli R, van Rooij I, Wijnen RM, et al. Transanal endorectal pull-through for classic segment Hirschsprung's disease: With or without laparoscopic mobilization of the rectosigmoid. J Pediatr Surg 2013;48:1914-8.
15. Song SH, Lee C, Jung J, Kim SJ, Park S, Park H, et al. A comparative study of pediatric open pyloplasty, laparoscopy-assisted extracorporeal pyloplasty, and robot-assisted laparoscopic pyloplasty. PLoS One 2017;12:e0175026.
16. Oomen MW, Hoekstra LT, Bakx R, Heij HA. Learning curves for pediatric pyloromyotomy: How many operations are enough? The Amsterdam experience with laparoscopic pyloromyotomy. Surg Endosc 2010;24:1829-33.
17. Vegunta RK, Woodland JH, Rawlings AL, Wallace J, Pearl RH. Practice makes perfect: Progressive improvement of laparoscopic pyloromyotomy results, with experience. J Laparoendosc Adv Surg Tech A 2008;18:152-6.
18. Ballouhey Q, Micle L, Gross C, Robert Y, Binet A, Arnaud A, et al. A simulation model to support laparoscopic pyloromyotomy teaching. J Laparoendosc Adv Surg Tech A 2018;28:760-5.
19. Anwar MO, Omran YA, Al-Hindi S. Laparoscopic pyloromyotomy: A modified simple technique. J Neonatal Surg 2016;5:3.