ORIGINAL ARTICLE

Laparoscopic vs Open Pyloromyotomy for Treatment of Infantile Hypertrophic Pyloric Stenosis

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Abstract

Background: ***Infantile Hypertrophic Pyloric Stenosis (IHPS) frequency is 1-2:1000 live births in the United States. It is presented in neonates aged 2-8 weeks. Male to female ratio is 4:1.***

Aim: ***To evaluate laparoscopic pyloromyotomy regarding surgical outcomes and incidence of complications versus open pyloromyotomy.***

Patients and methods: ***This randomized controlled study was conducted on thirty children less than three months who were diagnosed with IHPS and divided into two groups: fifteen cases in Laparoscopic group and fifteen cases in open group at pediatric surgery department, faculty of medicine, Al-Azhar university for the duration of 1 year.***

Results: ***According to outcome of treatment, there were big differences between the two groups regarding surgical time (about 12 minutes at laparoscopic group and about 21 minutes at open group), postoperative feeding (about 6 hours at laparoscopic group and about 24 hours at open group), hospital stays (about 2 days at laparoscopic group and about 5 days at open group), and postoperative vomiting (6/15 cases at laparoscopic group and 12/15 cases at open group). According to complications, there were some differences between the two groups regarding mucosal perforation (one case of mucosal perforation at the open group and zero cases at the laparoscopic group), and ugly scar (two cases at the open group and zero cases at the laparoscopic group).***

Conclusion: ***Both methods are safe and efficient in the management of IHPS. The laparoscopic method is related to a shorter surgical time, early postoperative feeding, shorter hospital stays and better cosmesis.***

Keywords: IHPS; open pyloromyotomy; laparoscopic pyloromyotomy

1. Introduction

Infantile Hypertrophic Pyloric Stenosis (IHPS) is one of the most frequent gastrointestinal disorders throughout early infancy, with a frequency of 1-2:1000 live births in the United States. This condition is presented in neonates most frequently between the ages of two and eight weeks. Males outnumber females in every series by a ratio of 4-5:1. There is a greater possibility for developing IHPS in offspring of parents with this condition, and in numerous series, First-born males are commonly encountered[1,2] The cause of pyloric stenosis is unknown. Familial, genetic, sex, and ethnic origin may impact IHPS frequency rates.

The gastric outlet is constricted and obstructed as a result of circular muscle hypertrophy of the pylorus in IHPS. Nonbilious, projectile emesis, hypochloremic, metabolic alkalosis, and dehydration are the consequences of gastric outlet obstruction.[3,4]

Since its first description in 1912, Ramstedt extra mucosal longitudinal pyloromyotomy or its modification, Tan-Bianch pyloromyotomy (OP) described in 1986 has been the standard management for IHPS.

Nevertheless, laparoscopic extra-mucosal longitudinal pyloromyotomy (LP), initially introduced in 1990, has experienced an increase in popularity over the past decade as a result of the advancement of laparoscopic technology and the development of fine instrumentation suitable for use in neonates. At present, pediatric surgeons are in disagreement regarding the superiority of longitudinal pyloromyotomy and open pyloromyotomy (OP).[5,6]

The goal of this investigation was to compare laparoscopic pyloromyotomy vs open pyloromyotomy and to know which of them is the safest and efficient approach for infantile hypertrophic pyloric stenosis management.

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2. Patients and methods

This randomized controlled investigation has been carried out on thirty children less than three months of age who diagnosis with infantile hypertrophic pyloric stenosis and classified into two groups: fifteen cases in Laparoscopic pyloromyotomy group and fifteen cases in open pyloromyotomy group at pediatric surgery department, faculty of medicine, Al-Azhar university for the period from September 2023 to September 2024.

Inclusion criteria: All children less than three months of age with symptoms, signs, or exam results suggesting an infantile hypertrophic pyloric stenosis diagnosis (in ultrasound muscle thickness≥4 mm, pyloric length of ≥16 mm. A thickness of >3 mm is considered positive if the neonate is younger than 30 days of age and pyloric index >25) have been included in this study.

Exclusion criteria: Suspected sepsis with vomiting, bilious vomiting suggesting intestinal obstruction, gastroenteritis, Gastroesophageal reflux disease (GERD), Milk allergy, and urinary tract infection (UTI), and past or present significant comorbidities or chronic conditions that would change methods of care.

Ethical Considerations: The information that has been collected from participants is considered confidential. The investigation's participants haven't been identified by name in any publication or report that addressed this investigation. The objective and nature of the investigation, as well as the risk-benefit assessment, have been conveyed to the participants prior to their admission to this investigation. Informed consent has been acquired.

Method:

All patients have been subjected to: Complete history taking, physical examinations, and investigational studies.

Procedures:

The procedure involves the identification of the gallbladder in a supine position using a transducer in a transverse position, occasionally with a slight anticlockwise rotation. The pylorus is typically situated slightly posterior and medial to the gallbladder. Pylorus measurements and appearance are evaluated, with the muscular layer being a hypoechogenic, thin layer that is less than two millimeters in thickness. The antrum pyloric region is distended by gastric content visualization passing via the pylorus. The presence of a wide-open pylorus and the normal passage of gastric contents eliminates Hypertrophic Pyloric Stenosis. To prevent gas filling, the neonate must be positioned in an oblique position with the right side facing downward. This position serves as an acoustic window, allowing fluid to enter the antrum. Alternative options involve administering water to the neonate or inserting a nasogastric tube, as artefacts may result from milk-filled stomachs. Accessing the pylorus may be difficult due to the fact that a significantly distended stomach may displace it dorsally.

Laparoscopic Approach

The procedure for laparoscopic pyloromyotomy started with the implantation of a five-millimeter umbilical port utilizing the open method. The insufflation rate has been set at one liter per minute, and the pneumoperitoneum has been established at a pressure of eight millimeters of mercury. The umbilical port has been used to introduce a 5-mm 30° camera. A three-millimeter atraumatic grasper has been inserted directly via a right upper quadrant stab incision, without the utilization of a port, to retract the inferior border of the liver superiorly and expose the hypertrophic pylorus. A three-millimeter retractable myotomy knife is inserted directly via a stab incision in the left upper quadrant. The duodenum has been subsequently grasped just distal to the pyloric mass and retracted in a lateral and slightly anterocephalic direction to reveal the hypertrophic pylorus' avascular surface. The diathermy or pyloric knife has been used to make a seromuscular incision over the hypertrophic pylorus. Myotomy knife should be inserted one to two millimeters proximal to the pyloroduodenal junction and should extend onto the gastric antrum at least 0.5–1.0 centimeters proximal to the antropyloric junction. Pyloromyotomy has been subsequently completed by replacing the myotomy instrument with an LP spreader. The stomach has been inflated via nasogastric tube (160–180 milliliters) to assess for mucosal injury.

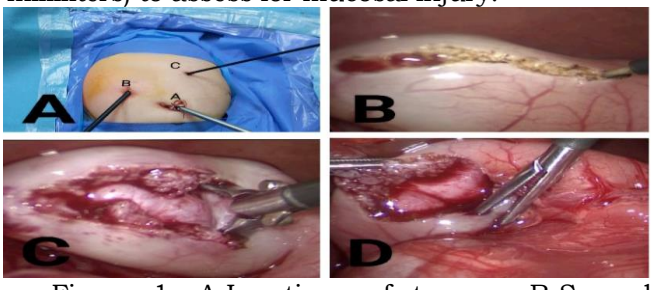

Figure 1. A-Locations of trocars, B-Serosal incision using hook diathermy, C-Mucosal bulge after muscle spreading, D-Show shine sign that ensures proper pyloromyotomy.

Open Approach

The cases had open pyloromyotomy via an upper right transverse incision (three to four centimetres). Pyloric tumor is determined after the stomach is visualized. Seromuscular wound is performed in an avascular plane from the vein of Mayo distally to the stomach antrum proximally, without delivering the stomach, utilizing a no. Fifteen-blade knife.

The muscle edges are carefully separated using a blunt instrument (mosquito forceps). The perforation test has been conducted by injecting thirty millilitres of air through the Ryle tube and gently passing it via the pyloric canal. The wound is closed in layers, and haemostasis is established.

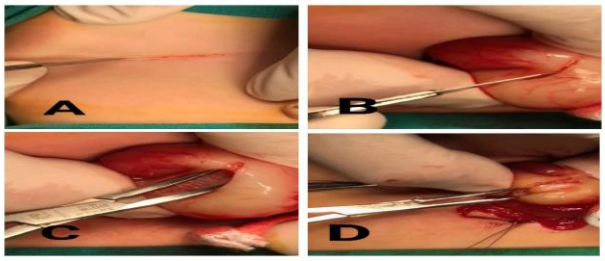

Figure 2. A-Rt. Subcostal skin incision, B-Serosal incision, C-Muscle spreading, D-Mucosal bulge.

Postoperative care:

After recovery, the patient was monitored for vital signs, removed the NG tube, and given intravenous fluids (IVI) at 120 ml/kg/day. As oral intake increased, IVI fluid was reduced. Minor vomiting was expected for one-week postoperative. The antibiotic for surgical site prophylaxis was Cefazolin, 25 milligrams per kilogram of body weight, with Clindamycin, 10 milligrams per kilogram of body weight, recommended for penicillin allergy patients.

Follow-up

In an outpatient clinic after one week, one month then 3 months. We took into consideration the parent's satisfaction and cosmetic results in patient questionnaire.

3. Results

Based on baseline characteristics, table 1 demonstrates that A statistically insignificant distinction has been observed among the investigated groups regarding weight, age, sex, associated anomalies and malnutrition.

Table 1. Distribution of baseline characteristics among the investigated groups.

	LAPAROSCOPIC PYLOROMYOTOMY GROUP (NUMBER=15)	OPEN PYLOROMYOTOMY GROUP (NUMBER=15)	P-VALUE
AGE (DAYS) MEAN ±SD	34.8±8.47	36.2±7.45	0.63
SEX			
MALE	12 (80%)	11 (73.3%)	0.67
FEMALE	3 (20%)	4 (26.7%)	
WEIGHT MEAN ±SD	3.26±0.44	3.46±0.52	0.27
ASSOCIATED ANOMALIES	0 (0%)	0 (0%)	1
MALNUTRITION	15 (100%)	15 (100%)	1

P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is highly significant. SD: standard deviation.

Based on clinical assessment, table 2 demonstrated that A statistically insignificant distinction has been observed among the investigated groups regarding onset of vomiting at about 3 weeks at both groups, non-bilious vomiting all patients on laparoscopic group and 14 of 15 patients at open group, projectile all patients on laparoscopic group and 13 of 15 patients at open group, dehydration 10 of 15 patients on laparoscopic group and 12 of 15 patients at open group and palpable mass 13 of 15 patients on laparoscopic group and 11 of 15 patients at open group.

Table 2. Distribution of clinical assessment among the investigated groups.

	LAPAROSCOPIC PYLOROMYOTOMY GROUP (NUMBER=15)	OPEN PYLOROMYOTOMY GROUP (NUMBER=15)	P-VALUE
ONSET OF VOMITING (WEEKS) MEAN ±SD	3.2±0.79	3.4±0.78	0.49
NONBILIOUS VOMITING	15 (100%)	14 (93.3%)	0.31
PROJECTILE	15 (100%)	13 (86.7%)	0.14
DEHYDRATION	10 (66.7%)	12 (80%)	0.41
PALPABLE MAS	13 (86.7%)	11 (73.3%)	0.36

Based on laboratory data, table 3 demonstrated that A statistically insignificant distinction has been observed among the investigated groups regarding hypokalemia, hypochloremia and metabolic alkalosis.

Table 3. Distribution of Laboratory information among the investigated groups.

	LAPAROSCOPIC PYLOROMYOTOMY GROUP (NUMBER=15)	OPEN PYLOROMYOTOMY GROUP (NUMBER=15)	P-VALUE
HYPOKALEMIA MEAN ±SD	3.21 ± 0.09	3.14 ± 0.1	0.053
HYPOCHLOREMIA MEAN ±SD	90.6 ± 1.5	89.2 ± 2.7	0.09
METABOLIC ALKALOSIS MEAN ±SD	7.47 ± 0.01	7.47 ± 0.02	1.00

Based on ultrasound (US) findings, table 4 demonstrated that A statistically insignificant distinction has been observed among the investigated groups regarding wall thickness, pyloric canal length, pylorus diameter.

Table 4. Distribution of ultrasound (US) findings among the investigated groups.

	LAPAROSCOPIC PYLOROMYOTOMY GROUP (N=15)	OPEN PYLOROMYOTOMY GROUP (N=15)	P-VALUE
WALL THICKNESS (MM) MEAN ±SD	4.76±0.49	4.95±0.48	0.29
PYLORIC CANAL LENGTH (MM) MEAN ±SD	17.6±1.42	17.2±1.44	0.45
PYLORUS DIAMETER (MM) MEAN ±SD	10.61±1.53	9.82±1.55	0.17
PYLORUS INDEX MEAN ±SD	28.65±1.34	29.23±1.44	0.15

Based on treatment outcome, table 5 demonstrates that A statistically significant distinction has been observed among the

investigated groups regarding surgical time as it was about 12 minutes at laparoscopic group and about 21 minutes at open group, time to oral intake as it was about 6 hours at laparoscopic group and about 24 hours at open group, length of hospital stay as it was about 2 days at laparoscopic group and about 5 days at open group, and postoperative vomiting as there were 6 of 15 cases at laparoscopic group and 12 of 15 cases at open group.

Table 5. Distribution of outcome of treatment among the investigated groups.

	LAPAROSCOPIC PYLOROMYOTOMY GROUP (NUMBER=15)	OPEN PYLOROMYOTOMY GROUP (NUMBER=15)	P-VALUE
SURGICAL TIME (MIN) MEAN ± SD	11.8 ± 2.04	21.3 ± 3.04	<0.001
TIME TO ORAL INTAKE (HOURS) MEAN ± SD	6 ± 0	23 ± 0.58	<0.001
LENGTH OF HOSPITAL STAYS (DAYS) MEAN ± SD	2 ± 0	5 ± 0.76	<0.001
POSTOPERATIVE VOMITING	6 (40%)	12 (80%)	0.02

Based on complications, table 6 demonstrated that A statistically insignificant distinction has been observed among the investigated groups regarding recurrence of vomiting and burst abdomen. However, a clinically significant distinction has been observed among the investigated groups regarding mucosal perforation as there was 1 of 15 cases at laparoscopic group and zero case at open group, wound infection as there was 1 of 15 cases at laparoscopic group and zero case at open group, ugly scar as there were 2 of 15 cases at laparoscopic group and zero case at open group.

Table 6. Distribution of complications among the investigated groups.

	LAPAROSCOPIC PYLOROMYOTOMY GROUP (NUMBER=15)	OPEN PYLOROMYOTOMY GROUP (NUMBER=15)	P-VALUE
RECURRENCE OF VOMITING	0 (0%)	0 (0%)	1
MUCOSAL PERFORATION	0 (0%)	1 (6.7%)	0.31
WOUND INFECTION	0 (0%)	1 (6.7%)	0.31
BURST ABDOMEN	0 (0%)	0 (0%)	1
UGLY SCAR	0 (0%)	2 (13.3%)	0.14

4. Discussion

According to demographic data, this result showed that A statistically insignificant distinction has been observed among the investigated groups regarding sex, weight, age, associated anomalies and malnutrition.

In agreement with Pogorelić et al.,[7] who aimed to compare therapy results in neonates with HPS between the traditional open approach and laparoscopic pyloromyotomy utilizing a three millimeter electrocautery hook, their investigation was carried out on 125 neonates, 83.2 percent of whom were male, with a median age of 33 days. Of these infants, 61 (48.8 percent) have been assigned to the open group, while 64 (51.2 percent) have been assigned to the laparoscopic group. They stated that a statistically insignificant distinction was observed among the investigated groups regarding sex, weight, age, associated anomalies, and malnutrition (p-value more than 0.05).

According to laboratory data, the present investigation revealed that A statistically insignificant distinction has been observed among the investigated groups regarding hypokalemia, hypochloremia and metabolic alkalosis.

Our study agreed with Huang et al.,[8] who found that A statistically insignificant distinction has been observed among the investigated groups regarding hypokalemia, hypochloremia and metabolic alkalosis.

According to ultrasound (US) findings, the present investigation demonstrated that A statistically insignificant distinction has been observed among the investigated groups regarding wall thickness, pyloric canal length, pylorus diameter.

In accordance with Dar et al.,[9] stated that A statistically insignificant distinction has been observed among the investigated groups regarding wall thickness, pyloric canal length, and pylorus diameter.

According to the outcome of treatment, our investigation revealed that a statistically significant distinction has been observed among the investigated groups regarding surgical time, time to oral intake, length of hospital stays, and postoperative vomiting.

Our results agreed with Huang et al.;[8] came to a conclusion that the efficacy of the two operations was comparable among the investigated groups. However, they additionally stated that the laparoscopic group of patients had a shorter operative time, a shorter time to oral intake following surgery, and a shorter hospitalization length. Their results are consistent with our own.

As well, in accordance with Mahida et al.,[10] who aimed to identify the effect of laparoscopic vs. open pyloromyotomy on postoperative length of stay (LOS), they demonstrated that patients who had laparoscopic surgery experienced quicker recovery and shorter hospital stay. According to complications, our outcomes demonstrated that A statistically insignificant distinction has been observed among the investigated groups regarding recurrence of vomiting, mucosal perforation, wound infection, burst abdomen,

ugly scar, and reoperations.

In supporting with Pogorelić et al.,[7] it has been determined that the incidence of postoperative vomiting was considerably greater in the OP group at 31.1 percent compared to the laparoscopic pyloromyotomy group at 15.6 percent (p-value equals 0.039). The median length of postoperative hospital stay was three days in laparoscopic pyloromyotomy group and six days in open pyloromyotomy group, with a p-value of less than 0.00001.

The laparoscopic pyloromyotomy group exhibited reduced rates of complications and reoperations; however, the distinctions weren't statistically significant (p-value equals 0.157 and p-value equals 0.113, respectively). Mucosal perforation was the most frequent complication in the two groups, with a rate of 4.9 percent in the open group and 3.1percent in the laparoscopic group. Wound infection was the second most frequent complication in the open group, with a rate of 4.9 percent. No wound infections were documented in the laparoscopic group. Diffuse peritonitis resulting from mucosal perforation necessitated reoperation in three children (4.9 percent) from the OP group. In the laparoscopic group, the two perforations were identified intraoperatively and treated with laparoscopic sutures of the mucosa, with no subsequent consequences.

Two cases in group A have been converted to an open approach (conversion rate five percent) due to perforation of the mucosa in one case and false suspicion of gastric injury in the other, as revealed by Ismail et al.,[11] In group A, two cases of mucosal perforation (five percent) have been observed. In one instance, it has been identified throughout the operation and repaired following the conversion to an open approach with an omental patch and a redo pyloromyotomy in another. The second case was presented twenty-four hours postoperatively in the same admission with persistent vomiting, abdominal pain, and fever.

Similarity, accordance with Zampieri et al.,[12] who aimed to compare the two surgical methods: the laparoscopic group and open pyloromyotomy, their study conducted on sixty cases have been managed for HPS and fifty-six males and four females with an average age of 38±14 days at surgery have been involved. They stated that no distinctions have been observed regarding duration of surgery, duration of hospitalization, postoperative complications, and weight at surgery time.

4. Conclusion

The management of hypertrophic pyloric stenosis is equally efficient and safe with open and laparoscopic pyloromyotomy. The laparoscopic method is related to a shorter duration of surgery, early post operative feeding, shorter hospital stays and better cosmetic results.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

References

1. Zhu J, Zhu T, Lin Z, Qu Y, Mu D. Perinatal risk factors for infantile hypertrophic pyloric stenosis: A meta-analysis. J Pediatr Surg. 2017;52(9):1389-1397. doi: 10.1016/j.jpedsurg.2017.02.017
2. Obaid YY, Toubasi AA, Albustanji FH, Al-Qawasmeh AR. Perinatal risk factors for infantile hypertrophic pyloric stenosis: A systematic review and meta-analysis. J Pediatr Surg. 2023;58(3):458-466. doi: 10.1016/j.jpedsurg.2022.08.016
3. Garfield K, Sergent SR. Pyloric Stenosis. In: StatPearls. Treasure Island (FL): StatPearls Publishing; January 30, 2023.
4. Hom J, Lam SHF, Delaney KM, Koos JA, Kunkov S. Vomiting, Pyloric Mass, and Point-of-Care Ultrasound: Diagnostic Test Accuracy for Hypertrophic Pyloric Stenosis-A Meta-Analysis. J Emerg Med. 2023;65(5): e427-e431. doi: 10.1016/j.jemermed.2023.06.001
5. Staerkle RF, Lunger F, Fink L, Sasse T, Lacher M, Elm E. et al. Open versus laparoscopic pyloromyotomy for pyloric stenosis. Cochrane Database Syst Rev. 2021;3(3):CD012827. Published 2021 Mar 9. doi: 10.1002/14651858.CD012827.pub2
6. Qassem MG, Dahish AH, Soliman MH, Matar M. Open versus Laparoscopic Pyloromyotomy for Infantile Hypertrophic Pyloric Stenosis. Ain Shams Journal of Surgery. 2024 Jan 1;17(1):29-39. DOI: 10.21608/ASJS.2024.336998
7. Pogorelić Z, Zelić A, Jukić M, Llorente Muñoz CM. The Safety and Effectiveness of Laparoscopic Pyloromyotomy Using 3-mm Electrocautery Hook versus Open Surgery for Treatment of Hypertrophic Pyloric Stenosis in Infants. Children (Basel). 2021;8(8):701. Published 2021 Aug 13. doi:10.3390/children8080701
8. Huang WH, Zhang QL, Chen L, Cui X, Wang YJ, Zhou CM. The Safety and Effectiveness of Laparoscopic versus Open Surgery for Congenital Hypertrophic Pyloric Stenosis in Infants. Med Sci Monit. 2020;26: e921555. Published 2020 May 14. doi:10.12659/MSM.921555
9. Dar OA, Ahmed N, Afzal T, Aziz M. Comparison of post-operative complications, operative time and hospital stay between laparoscopic and open pyloromyotomy. The Professional Medical Journal. 2023 May 31;30(06):689-94.
10. Mahida JB, Asti L, Deans KJ, Minneci PC, Groner JI. Laparoscopic pyloromyotomy decreases postoperative length of stay in children with hypertrophic pyloric stenosis. J Pediatr Surg. 2016;51(9):1436-1439. doi: 10.1016/j.jpedsurg.2016.05.006
11. Ismail I, Elsherbini R, Elsaied A, Aly K, Sheir H. Laparoscopic vs. Open Pyloromyotomy in Treatment of Infantile Hypertrophic Pyloric Stenosis. Front Pediatr. 2020; 8:426. Published 2020 Aug 21. doi:10.3389/fped.2020.00426
12. Zampieri N, Corato V, Scirè G, Camoglio FS. Hypertrophic Pyloric Stenosis: 10 Years' Experience with Standard Open and Laparoscopic Approach. Pediatr Gastroenterol Hepatol Nutr. 2021;24(3):265-272. doi:10.5223/pghn.2021.24.3.265