Comparing Long-term Outcomes of Laparoscopic and Open Ladd's Procedures in Children with Malrotation

Jana DeJesus, MD[1]; Geetha L. Radhakrishnan, MD[2], Ravi S. Radhakrishnan, MD[1]
The University of Texas Medical Branch at Galveston
1 Department of Surgery 2 Department of Pediatrics

BACKGROUND

Pediatric malrotation has traditionally been managed with open Ladd's procedure. A growing number of pediatric surgeons are utilizing the laparoscopic approach given its potential benefits of reducing postoperative pain, length of stay, and risk of small bowel obstruction.[1] However, laparoscopy may not be as effective as the open approach due to the reduced amount of adhesion formation and increased difficulty in counterclockwise rotation of the bowel.[1-5] Studies comparing outcomes in open and laparoscopic approaches have been limited by small sample sizes and short length of follow up.

The aim of this study was to examine long-term outcomes in pediatric patients undergoing open and laparoscopic Ladd's procedures, specifically 1 month, 6 months, and 12 months out from initial surgery.

METHODS

Retrospective study (January 1, 2003 – January 1, 2023) of pediatric patients (≤ 17yrs who underwent open (CPT 4405) or laparoscopic (CPT 44180, 44238) Ladd's procedures. Database: TriNetX international Research Network

Laparoscopic Ladd's Procedure

Open Ladd's Procedure

Primary Outcomes of interest: reoperation, small bowel obstruction, surgical site infection, respiratory complications, and mortality

Subanalysis: characteristics of subjects in laparoscopic and open Ladd's procedure groups

Statistically significant results in red (p>0.05)
^ Incidence too small to calculate odds ratio

RESULTS

DEMOGRAPHICS

	Laparoscopic (N=345)	Open (N=1360)
Age at Index (yrs)	6.96 ± 6.17	3.45 ± 5.12
Male	164	713
Female	181	602
White	243	788
Black	44	213
Asian	10	40
Other	24	53
Hispanic	42	273
Non-Hispanic	879	879

SHORT TERM OUTCOMES

	Time Frame		
Outcome	1 Month	6 Months	12 Months
Surgical Site Infection	OR 1.59 CI 0.753,3.358 p=0.220	-	-
Respiratory Complications	OR 0.79 CI 0.39-1.60 p=0.51	-	-
Pneumonia	OR 2.11 CI 0.9640-4.618 p=0.056	-	-
LONG TERM OUTCOMES			
Redo Procedure	Laparoscopic: 7 (2%) Open: 14 (1%) OR 3.79 CI 1.56-9.17 p=0.002	^	^
Small Bowel Obstruction	OR1.46 CI 0.74-2.88 p=0.27	OR 0.94 CI 0.46-1.91 p=0.87	Laparoscopic: 10 (3%) Open: 11 (0.8%) OR 3.80 CI 1.56-9.21 p=0.001
Recurrent Volvulus	OR 1.51 CI 0.71-3.20 p=0.29	Laparoscopic: 12 (3%) Open: 16 (1%) OR 2.69 CI 1.17-6.21 p=0.02	^
Mortality	^	^	^

OPEN VS LAPAROSCOPIC PRE-OPERATIVE CHARACTERISTICS

Characteristic	Laparoscopic (N=345)	Open (N=1360)	*P*-Value
Volvulus at Index	35 (10%)	253 (19%)	< 0.0001
Chronic Abdominal Pain	133 (39%)	371 (28%)	0.0002
Prematurity	23 (7%)	157 (12%)	0.0052
Low Birth Weight (<2000g)	18 (5%)	93 (7%)	0.10
Extremely Low Birth Weight (<1000g)	10 (3%)	65 (5%)	0.22
Congenital Malformations			
Pulmonary	22 (6%)	135 (10%)	0.028
Cardiac	72 (21%)	426 (32%)	<0.0001
Neurological	23 (7%)	90 (7%)	0.913
Urinary	15 (4%)	100 (8%)	0.034
Genital	20 (6%)	89 (7%)	0.521

LAPAROSCOPIC SUBJECTS REQUIRING REOPERATION

Outcome	Reoperation (N=45)	No Reoperation (N=291)	*P*-Value
Prematurity	10 (22%)	17 (4%)	<0.0001
Extremely Low Birth Weight Newborn	10 (21%)	10 (3%)	<0.0001
Volvulus at Index	19 (40%)	45 (12%)	<0.0001
Congenital Respiratory Anomalies	10 (21%)	15 (6%)	0.29
Congenital Cardiac Anomalies	10 (22%)	62 (16%)	0.31
Congenital Neurological Anomalies	10 (22%)	24 (6%)	0.0002

DISCUSSION

Our study found that subjects who underwent laparoscopic Ladd's procedure tended to be older (6.96yrs ± 6.17) and have a diagnosis of chronic abdominal pain. Subjects undergoing open Ladd's procedure were younger (3.45yrs ± 5.12), diagnosed with volvulus at presentation, and born premature. These results suggest a preference for open Ladd's in emergent cases which reflects findings of other studies.[2-5] Results of our subanalysis reiterate these findings. Subjects who initially underwent laparoscopic Ladd's and required reoperation were more likely to be premature, extremely low birthweight, and have volvulus at presentation.

The most common congenital malformations in our sample were cardiac, pulmonary, and urinary. Subjects who underwent open Ladd's procedure had a higher prevalence of these malformations compared to those who underwent laparoscopic Ladd's procedure. A limited number of studies have documented the incidence of concomitant congenital defects in children with malrotation. Our results indicate children undergoing open Ladd's have an increased odds of having concomitant congenital malformations compared to those undergoing the laparoscopic approach.

Notably, subjects undergoing laparoscopic Ladd's procedure were at higher odds of undergoing a redo operation within the first 30 days post-op (OR 3.79) and having recurrent volvulus within the first 6 months post-op (OR 2.69). Similar results have been found in other studies.[2-5] Interestingly, the laparoscopic sample had a higher odds of small bowel obstruction at 12 months after index operation (OR 3.80). This is contrary to evidence found in other studies and the underlying assumption that the open approach increases adhesion formation.[4-6] Subjects who fell into this group may have had longer operations or volvulus at presentation. Further subanalysis of this group will be needed.

CONCLUSION

Patients undergoing laparoscopic Ladd's procedures for malrotation tend to have fewer comorbidities but are at higher risk of reoperation. Careful consideration of Ladd's approach should be taken based on patient factors and surgeon experience should be taken.

REFERENCES

1. Svetanoff WJ, Srivatsa S, Diefenbach K, Nwomeh BC. Diagnosis and management of intestinal rotational abnormalities with or without volvulus in the pediatric population. Semin Pediatr Surg. 2022;31(1):151141. doi:10.1016/j.sempedsurg.2022.151141
2. Ferrero L, Ahmed YB, Philippe P, et al. Intestinal Malrotation and Volvulus in Neonates: Laparoscopy Versus Open Laparotomy. J Laparoendosc Adv Surg Tech A. 2017;27(3):318-321. doi:10.1089/lap.2015.0544
3. Zhang Z, Chen Y, Yan J. Laparoscopic Versus Open Ladd's Procedure for Intestinal Malrotation in Infants and Children: A Systematic Review and Meta-Analysis. J Laparoendosc Adv Surg Tech A. 2022 Feb;32(2):204-212. doi: 10.1089/lap.2021.0436. Epub 2021 Oct 4. PMID: 34609912.
4. Isani MA, Schlieve C, Jackson J, et al. Is less more? Laparoscopic versus open Ladd's procedure in children with malrotation. J Surg Res. 2018;229:351-356. doi:10.1016/j.jss.2018.04.016
5. Huntington JT, Lopez JJ, Mahida JB, et al. Comparing laparoscopic versus open Ladd's procedure in pediatric patients. J Pediatr Surg. 2017;52(7):1128-1131. doi:10.1016/j.jpedsurg.2016.10.046
6. Zhu H, Zheng S, Alganabi M, et al. Reoperation after Ladd's procedure in the neonatal period. Pediatr Surg Int. 2019;35(1):117-120. doi:10.1007/s00383-018-4382-6