



Jejuno-ileal atresia: evaluation of the efficacy of laparoscopic approach

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Abstract

Aim Jejuno-ileal atresia is a main cause of neonatal intestinal obstructions, and minimal access technique is gaining popularity. Aim of this study was to perform systematic review of laparoscopic approach with regards its management efficacy.

Methods Pubmed® was searched using terms ‘jejunal’, ‘jejuno-intestinal atresia’, ‘laparoscopic’ or ‘laparoscopic-assisted’. Data collected included gender, age, weight, comorbidities, surgical technique, duration of surgery, complications, reoperation, mortality, parenteral feeding time.

Results 5 articles (2004–2020) met the inclusion criteria with 63 neonates. Mean weight was 2.6 kg. There were $n = 16$ comorbidities: cardiac anomalies ($n = 5$), Meckel’s diverticulum ($n = 2$), meconium peritonitis ($n = 4$), unknown ($n = 5$). All patients had laparoscopic-assisted surgery, out of which $n = 25$ were single-port approach. Conversion was reported in $n = 4$ cases due to meconium ileus ($n = 2$), or significantly dilated bowel ($n = 2$). There were $n = 7$ complications ($n = 1$ sepsis, $n = 2$ anastomotic leaks, $n = 1$ cholestasis, $n = 3$ adhesive ileus). Two reoperations were necessary because of anastomotic dehiscence ($n = 1$) and adhesive ileus ($n = 1$). Mean parenteral feeding time was 13 days. There were three lethal outcomes, due to sepsis after anastomotic leak ($n = 1$), severe cardiac defect ($n = 1$), pneumonia and adhesive ileus ($n = 1$).

Conclusions Laparoscopic-assisted is opted for jejuno-ileal atresia when minimal access approach is preferred. It is fast and feasible technique, which offers better cosmesis, may result shorter length of operation and recovery. There is $> 10\%$ complication rate, which rarely require reoperation. Limitation of this approach are low weight babies with associated anomalies, or significantly dilated proximal bowels. These remain the main concern for laparoscopic-assisted surgery, which require open approach or conversion.

Keywords Jejuno-ileal atresia · Jejunal atresia · Laparoscopic-assisted · Laparoscopic

Background

Jejuno-ileal atresia (JIA) is a well-recognized and relatively common neonatal intestinal anomaly, which is a major cause of intestinal obstruction [1]. The management of JIA has improved in recent decades, due to early diagnosis, developing neonatal intensive care service, nutritional support, and the appearance of minimal invasive operative technique [1–4]. The prevalence of JIA is approximately 1:330–1:1500 live births, however every third of them are either premature

or small for gestational age [2]. Prenatal diagnosis is successful in 29–50% by ultrasound examination [1].

The classic operative technique is a transverse upper abdominal laparotomy or a circumumbilical approach first used for pyloromyotomy by Tan and Bianchi [5]. This latter technique uses a three-quarter circle incision around the umbilicus, and a midline deep fascial and peritoneal incision. Later Soutter and Askew improved Bianchi’s method in the management of many neonatal abdominal anomalies, including small bowel atresia or malrotation [6]. Soutter’s technique needs a 350° incision around the umbilicus, leaving only a small percutaneous bridge, but having an extended view [2, 6]. Soutter had no umbilical ischemia among his patients.

Recently, minimal invasive techniques have gained popularity in the treatment of neonatal abdominal anomalies, either laparoscopy (duodenal atresia, pyloric stenosis,

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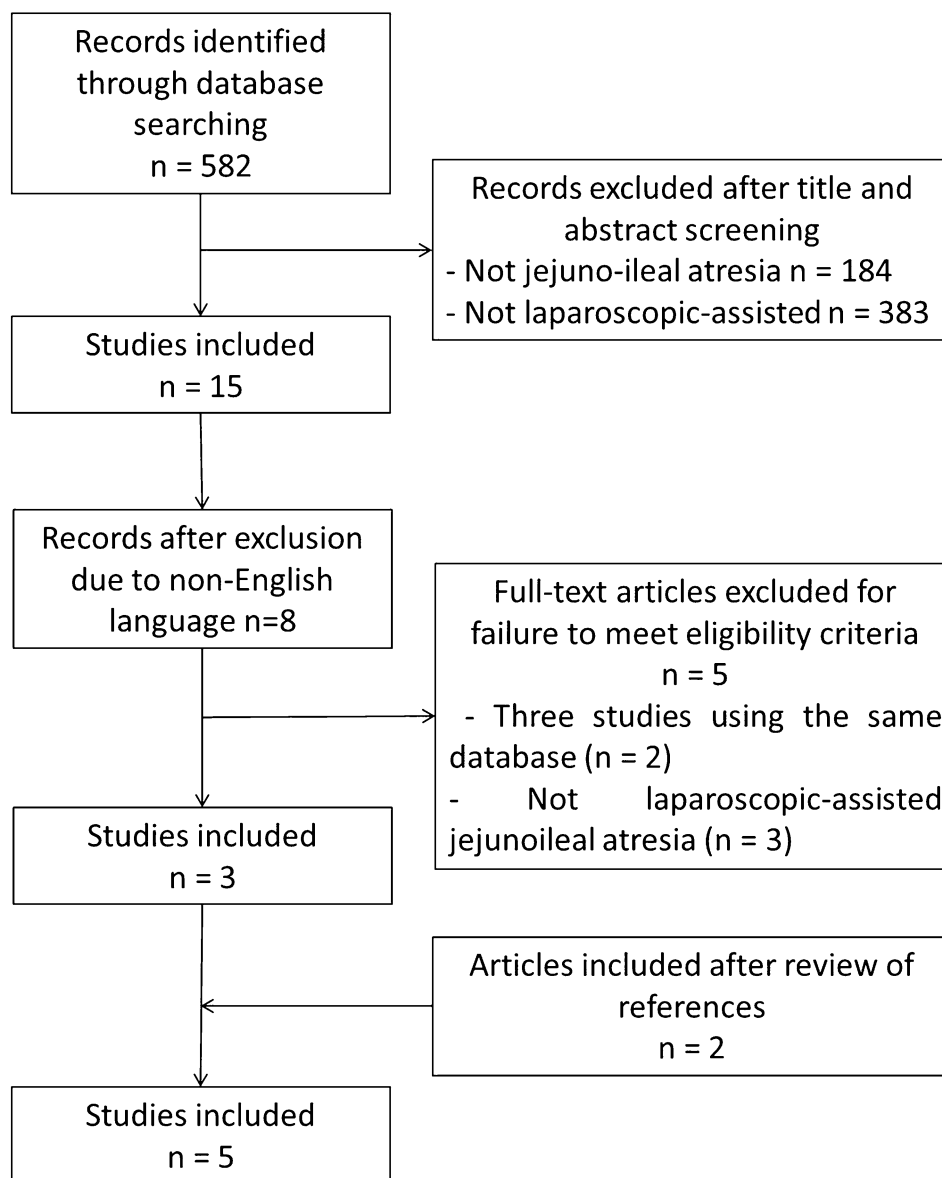
intestinal malrotation, duplication anomalies, or inguinal hernia) or laparoscopic-assisted technique (Meckel's diverticulum, imperforate anus, high anorectal malformation, Hirschsprung's disease) [7]. Totally laparoscopic repair in case of JIA still has not been published to date, due to the difficulty of intracorporal suturing and small abdominal working space. Nevertheless, totally laparoscopic management has been already described for duodenal atresia and it has improved in recent years, but is still not widely practiced, and has many controversies [2, 8]. Nowadays, there are two main concepts for minimal invasive technique of JIA: circumumbilical incision and laparoscopic-assisted surgery (LAS) [2]. We still have little experience and data about LAS in the management of jejuno-ileal atresia. In our study we made a systematic research in the topic, collected the

articles, and summed up the benefits and limitation of this approach.

Methods

A systematic research of Pubmed® was done using terms 'jejunal', 'jejuno-intestinal atresia', 'laparoscopic' or 'laparoscopic-assisted'. A total of 582 articles were found, and selected. Inclusion criteria were studies with description of cases of JIA treated by minimal-invasive technique and reports published in English. Those papers written not in English, describing non-laparoscopic/laparoscopic-assisted operations, have unclear case documentation or not being available for full-length were excluded. Figure 1 shows the

Fig. 1 Flow diagram of the exclusion and inclusion criteria



detailed process of selection. After exclusion five studies met the inclusion criteria with 63 neonates. There were three articles, that were supposed to examine partially the same database of patients: with the same author, in the same institution, at partially the same time, thus we used only the article with the largest data [3, 9, 10]. Data were collected for gender, age, weight, symptoms, comorbidities, surgical technique, mean duration of surgery, complications, reoperation, mortality, parenteral feeding time, hospitalization.

Results

Five articles were revealed studying laparoscopic-assisted approach of jejunoileal atresia. No purely laparoscopic management was found in the literature. The five studies (published between 2004 and 2020) involved 63 neonates [2, 7, 11–13] (Table 1). There are four case reports [7, 11–13], and one with a retrospective study comparing open versus laparoscopic-assisted surgery among own patients [2]. All of them had enough detailed information to be involved in our study. There were 40 males (63%) and 23 females (37%). Mean gestational age at the time of birth was 35 weeks (range between 34 and 39 weeks) with 19 premature neonates born before 37 weeks. Average birth weight was 2.6 kg, with 15 babies below 2500g, although all of them had laparoscopic-assisted operation without conversion, any

further complication or need of reoperation [2, 7, 13]. Successful prenatal diagnosis was made in 37 patients (59%), while 26 diagnosis (41%) were based on symptoms appearing in the first few days of life (vomiting, abdominal distension, cardiopulmonary compromise) [11, 13]. Associated comorbidities were present in 16 patients (25%): structural cardiac defect ($n=5$), Meckel's diverticulum ($n=2$), meconium peritonitis ($n=4$) and unknown in $n=5$ cases.

All of the 63 neonates were treated with laparoscopic-assisted surgery. The majority of authors used 5-mm trocar for camera, which was introduced through a transumbilical or supraumbilical incision [2, 7, 11–13]. An additional trocar (with 3- or 5-mm diameter) was placed in the left or right lower abdominal quadrant [2, 7, 12, 13], or two trocars [7] in a suitable position, mostly in the upper abdomen. One study described using single-port approach (laparoendoscopic single-site surgery (LESS)) in 25 cases [12]. After inspecting the abdomen and finding the atretic bowel, all the authors exteriorized the selected bowel segment through the umbilical port incision (or through single-port incision). Considering the high elasticity of neonatal umbilical ring, small bowel can easily be exteriorized without widening the wound. However, using a retractor [11] or enlarging the wound to approximately 2.5–3 cm can also be a valuable choice [13]. Most of the authors examined the whole small bowel extraabdominally searching for multiple atresia(s). Alternatively, using three trocar sites, the bowel may be

Table 1 Characteristics of the newborns and managements

Author	Yamataka et al. [11]	Abhyankar et al. [7]	Li et al. [12]	Li et al. [13]	Lima et al. [2]
Publication	2004	2011	2012	2015	2020
No. of patients	$n=3$	$n=2$	$n=35$	$n=4$	$n=19$
Average gestational week at birth	37	36	37	37	34
Average weight at surgery (kg)	3.2	2.5	2.7	2.7	2.5
Comorbidities (n)	No	No	Structural cardiac defect (5) Meckel diverticulum (2) Meconium peritonitis (3)	Meconium peritonitis (1)	(5)
Type of atresia (n)	–	IV. (1)	I. (5) II. (10) III/A (15) III/B (3) IV. (2)	III/B (2) IV. (2)	I. (2) II. (3) III/A (9) III/B (2) IV. (3)
Reoperation (n)	No	No	Adhesions (1)	No	Anastomotic leak (1)
Mortality (n)	No	No	Prematurity (1), Pneumonia and ileus (1) Associated cardiac defect (1)	No	No
Complications (n)	No	No	Adhesions(3), Anastomotic leak (1)	Cholestasis (1)	Anastomotic leak (1), Sepsis (1)
Duration of surgery (min)	–	–	48	80	112

inspected intraabdominally [7]. It is possible to irrigate the bowel with NaCl to find any additional atretic site. Laparoscopic-assisted technique has the advantage of a hand-sewn anastomosis under direct vision. In most of the cases ($n=58$), a primary anastomosis was performed, except for the $n=5$ cases with perforation or with questionable bowel viability [2]. In these latter cases, temporary ileostomy was done. After completion of the anastomosis, the bowel can be returned to the abdominal cavity, and a re-inspection is necessary in the abdomen for excluding kinking or torsion of the anastomosis. Li et al. [13] published simultaneous lengthening of short bowel. They used laparoscopic-assisted technique, where an antimesenteric flap was tubularized manually after exteriorization.

There were 7 type I., 13 type II., 24 type III/a, 7 type III/b and 8 type IV atresia ($n=4$ unknown) (Fig. 2). All multiple atresias were found during surgery, and none of them were missed or required second surgery. There was not enough information to calculate here a definitive rate for short bowel syndrome.

Only three articles mentioned duration time of surgery: Li et al. [12] had an average 48 min (40–65 min), in another article Li [13] described an average 80 min (65–110 min), where the operation contained also a bowel lengthening process, and Lima et al. [2] had an average 112 min.

Four conversions became inevitable [2, 11]. Two of them had meconium ileus with perforation and pseudocyst, while the rest of them had significantly dilated proximal bowel, which allowed insufficient working space for the surgeon.

The rate of postoperative complications was 11% ($n=7$) [2, 12, 13]. One newborn had sepsis [2], two had anastomotic dehiscence [2, 12], one cholestasis [13] and three of them had ileus due to adhesions [12]. There were two

reoperations: (1) one baby with anastomotic dehiscence, (2) another neonate with adhesions. The other two neonates having ileus were treated conservatively. One premature infant (1.7 kg) who suffered from anastomotic leak and incomplete intestinal obstruction did not have reoperation due to poor general condition [12]. Two other patients died after jejunoleal repair; one due to serious associated cardiac defect, and the other, who had type III/a atresia with meconium peritonitis, died 3 months after surgery due to pneumonia and adhesive ileus [12].

Overall meantime of parenteral feeding was 13 days [2, 12, 13]. Mean hospitalization was 21 days [3, 12, 13].

Discussion

The management of JIA has shifted to minimal invasive approach in the recent decades [1, 2]. Although laparoscopic-assisted approach using a transumbilical incision is not a new concept, Yamataka et al. [11] was the first who performed it and published in case of JIA in 2004. They used a transumbilical wound and an additional trocar. During bowel exteriorization the umbilical site was widened by a Scott self-retaining retractor (the same as being used for anorectal procedures) to ensure a good visualization. This approach has a good cosmetic result, and a hand-sewn anastomosis can be easily done.

The following publications of LAS described modified technique and performed in larger sample size. With the help of two additional trocars the bowels can be mobilized more easily and distal atresias can be searched intraabdominally, while there is a minimal stretching on the wound without any retractor [7]. In 2012, Li et al. [12] first described single-port approach (laparoendoscopic single-site surgery (LESS)), and also, they were the first who published their experience with a bigger number of patients ($n=35$). Three years later, Li et al. [13] reported the management of intestinal lengthening in the first time, using LAS. They used the Onofre's technique with an anterior flap from the antimesenteric border of the dilated blind proximal segment [14]. In 2020, a retrospective cohort study compared LAS and open (extended supraumbilical transverse laparotomy) management of JIA [2]. Examining 47 patients' data ($n=19$ LAS and $n=28$ open technique, operative time, parenteral feeding time, complications, length of hospitalization were compared. They found that LAS (112 ± 46 min) was shorter, than open surgery (138 ± 40 min). Authors believe that avoiding extensive wound of the abdominal wall and its time-consuming closure resulted in shorter operative length. The ability to enteral feeding was also earlier after LAS, but there was no difference in the length of parenteral feeding or duration of hospital staying. A slightly higher rate of postoperative

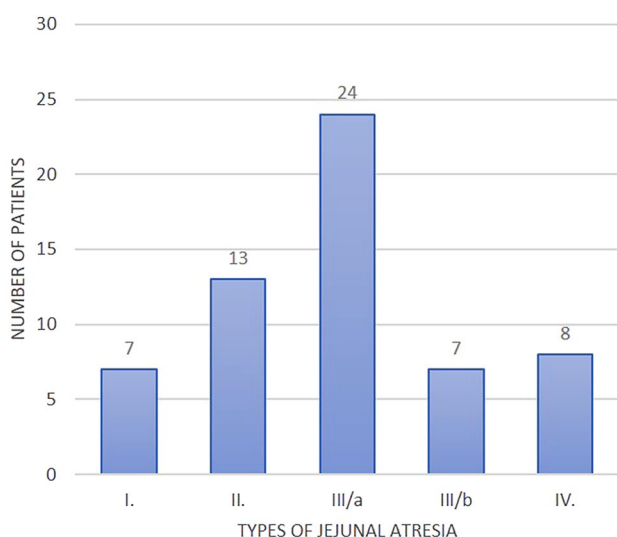


Fig. 2 Number of patients and types of atresias

complications was noticed in the open group (18%), compared with the group operated by LAS (10%) [2].

Based on the aforementioned five articles LAS is a fast and safe management, combining the advantage of laparoscopic technique and rapid hand-sewn anastomosis. All the five reports described excellent cosmetic, even virtually scar-free result in long term [2, 7, 11–13]. The minimized incision and preparation lower recovery time and postoperative pain [15]. LAS is a simple technique and does not require advanced laparoscopic skills. Furthermore, using laparoscope does not lengthen operative time [2], and if any difficulties occur, conversion into laparotomy becomes easy and fast. Articles demonstrated that bowel examination can be safely managed, since all the multiple atresias were identified and resected by LAS [2, 7, 11–13].

However, one of the potential limitations of LAS is the significantly dilated proximal bowel, which requires conversion in 3% of cases [2, 7, 11–13]. Among the five articles the overall conversion rate was 6%, due to meconium ileus with perforation and pseudocyst ($n=2$), and significantly dilated proximal bowel ($n=2$) with subsequent respiratory instability and reduced abdominal space [2, 11]. Nevertheless, LAS can easily be converted through the umbilical wound. In the majority of cases simple resection and primary anastomosis can be done, however ileostomy, tapering enteroplasty, or bowel lengthening can also be managed through LAS approach.

These aforementioned publications showed that LAS can be safely performed even in babies with low weight (even below 2500g). 19 premature newborns (< 37 gestational weeks) were published in these 5 articles, and 15 babies below 2500g. One premature baby (1.7 kg), who had incomplete obstruction and anastomotic leak after surgery, died due to poor general condition. In spite of this, the authors had great outcomes with LAS in case of low weight neonates [2, 7, 13], but they all agreed to select patients considering the serious comorbidities, instable hemodynamic status, or respiratory compromise. To conclude, beside dilated proximal bowels weight and comorbidities could be the other limitation for using LAS.

There was an overall 11% rate of postoperative complications, however only two of them required reoperations. There were no wound complications, and patients had excellent cosmetic result [2, 7, 11–13].

Conclusions

Laparoscopic-assisted technique with bowel exteriorization and anastomosis is opted for jejuno-ileal atresia when minimal access approach is preferred. It is a fast and feasible technique, which offers a better cosmesis, may result in a shorter length of operation, and even a shorter recovery

time. It has the advantage and safety of manual anastomosis. Even in case of short bowel syndrome when lengthening process is required it can be a valuable approach. There is a complication rate of > 10%, which rarely require reoperation. The limitations of this approach are very low weight babies with serious associated anomalies, or the significantly dilated proximal bowels. These remain the main concern for laparoscopic-assisted surgery, which require open approach or conversion.

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