

ORIGINAL ARTICLE

# Minimally-invasive liver resection in pediatric patients: initial experience and outcomes

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## Abstract

**Background:** Minimally Invasive Liver Resection (MILR) is an evolving procedure in the adult population for benign and malignant lesions, offering less morbidity while maintaining acceptable outcomes. However, there lacks a published MILR experience in the pediatric population besides case reports. This report describes a pediatric MILR experience in terms of pathology, clinical specifics, and patient outcomes.

**Methods:** This is a retrospective review of 36 pediatric patients undergoing MILR for benign and malignant conditions. MILR was performed by pure laparoscopy, hand-assisted laparoscopy, and a hybrid laparoscopic assisted method. Data points reviewed include patient demographics, pathology, operative technique, complications, and recurrence.

**Results:** Patients with benign (15) and malignant (21) conditions underwent segmentectomy, sectionectomy, or hemihepatectomy by MILR. Thirty-one were completed with pure laparoscopy and 20 underwent hemihepatectomy. Operative time and blood loss correlated with magnitude of resection with five patients requiring a blood transfusion. Complications were minor and included a seroma, port infection, port dehiscence, line infection, and hypertrophic scar. At median follow-up of 12 months (range 6–36 months), there were no mortalities, re-operations, or recurrences.

**Discussion:** MILR can be performed in pediatric patients for benign and malignant conditions with good technical and oncologic outcomes and low morbidity.

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## Introduction

Minimally invasive surgery has become an integral part of many surgical treatment algorithms for both benign and malignant conditions. Through clinical experience, authors have described techniques for laparoscopic liver surgery with favorable outcomes in the adult population.<sup>1</sup> Laparoscopic liver surgery is now an established treatment for curative intent of benign and malignant conditions of the liver in adults.<sup>1–3</sup>

This was presented in oral format at the American Academy of Pediatrics Surgery Section in Orlando, FL in October, 2013. It is not currently submitted to any other journal for consideration.

Pediatric surgery has seen a similar evolution in minimally invasive surgery. Currently, a wide variety of surgical diseases are treated using minimally invasive techniques.<sup>4–10</sup> The application of minimally invasive surgery to pediatric patients requires advanced techniques to facilitate the success of complex operations within the limited peritoneal domain of children. As with adults, laparoscopic liver surgery has been one of the last evolutions to occur in this paradigm. The development of laparoscopic techniques for liver resections in adults have shown a decreased operative blood loss and decreased length of stay when compared to open approaches.<sup>1,11</sup> In addition, there are the benefits of smaller incisions. These same benefits may translate to the pediatric population.

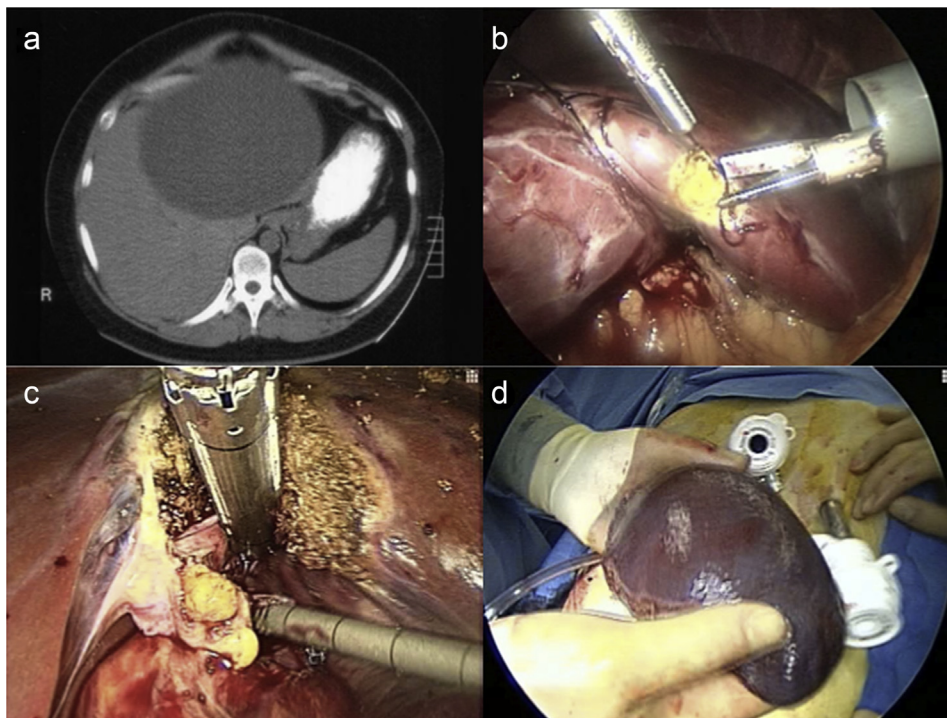
Besides the use of laparoscopy for biliary surgery, there is little published experience in pediatric laparoscopic liver resection.<sup>12–15</sup> The published experience thus far consists of case reports of small, peripheral, isolated lesions.<sup>16–20</sup> This report represents the first series of minimally invasive liver resection (MILR) for curative resection of both benign and malignant pediatric hepatic pathology. The aim is to retrospectively review the authors' initial experience with MILR in the pediatric population.

## Methods

After obtaining IRB exemption status, a database of pediatric patients that underwent MILR was reviewed. Patients undergoing MILR were entered into a database at the time of patient care based on intention to treat and then de-identified. All patients underwent clinical evaluation, diagnosis, and perioperative treatment by contemporary standards. Patients with benign conditions underwent resection for persistent symptoms or unknown diagnosis and concern for malignancy. Patients requiring surgical intervention were considered for MILR based on patient characteristics, lesion location and pathology, maintenance of oncologic principles, and technical considerations of resection. Patients who were not considered for MILR included those that would not tolerate laparoscopy, malignant lesions that

could not be safely removed with adequate margins laparoscopically, and those with lesions too close to major vascular or biliary structures on imaging to allow safe laparoscopic resection. One surgeon performed or assisted in all MILR operations. Retrospective review included patient age, lesion type, lesion location and size, type of resection, intraoperative and post-operative course, complications, and recurrence. Minimal blood loss on record was recorded as 10 cc. There were no missing data points in the database.

Operations included segmentectomy, sectionectomy, and hemihepatectomy.<sup>21,22</sup> Minimally invasive techniques used included pure laparoscopy, hand-assist laparoscopy, and laparoscopic assisted open resection, also called the hybrid procedure.<sup>1,22,23</sup> In all patients, intraoperative laparoscopic ultrasound was used to demarcate resection margins and intrahepatic vascular and biliary structures. Laparoscopic mobilization of the liver was completed. During a hemihepatectomy, the portal vein, hepatic duct, and hepatic artery were either dissected and controlled or transected using a laparoscopic stapling device. Parenchymal transection, cut surface inspection, and specimen extraction were then completed. Parenchymal transection in all cases was performed using a co-apptive sealing device and laparoscopic stapling devices. The hepatic vein was transected using a laparoscopic stapling device. Malignant lesions were placed in a bag and removed from the umbilical port intact, with extension



**Figure 1** Imaging from pediatric patients undergoing MILR. a. This is the preoperative CT scan of a symptomatic simple cyst in an 8 year old patient who will undergo pure laparoscopic MILR. b. This picture was taken during pure laparoscopic resection of a 5 cm lesion of segments 5 and 6. c. This image shows stapler division of the portal triad during a laparoscopic left lateral sectionectomy for hepatoblastoma after neoadjuvant chemotherapy. d. This image shows the left lobe of the liver following laparoscopic resection in a 12 year old patient

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