



# Pediatric laparoscopic cholecystectomy with 2.3 mm Percutaneous Surgical System (MiniLap<sup>®</sup>): A new frontier for pediatric mini laparoscopy?



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## ABSTRACT

Mini-laparoscopy represents an evolving and attractive field both in general and in pediatric surgery, with a pressing and increasing technical demand. Although the advantages of the mini-laparoscopic approach (reduced morbidity, less incisional pain and discomfort, better cosmetic results) are well recognized, its technical difficulties due to the lack of suitable and comfortable instruments brought to a limited use. Moreover, in the pediatric population, the need of ergonomic mini-invasive but efficient devices is the key of a widespread use of mini-laparoscopic surgery performed with an effective and safe technique. We aim to highlight the first case of pediatric laparoscopic cholecystectomy performed with 2.3 mm percutaneous instruments (MiniLap<sup>®</sup> Percutaneous Surgical System, Teleflex Incorporated, USA) that represents a significant advance in minimally invasive surgery.

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Laparoscopic technique has become a safe and effective alternative to conventional surgery also in children [1]. It is associated with shorter LOS and improved quality of life with less pain and better aesthetic results; it has become the preferred surgical treatment option also by parents. Nowadays, the widespread use of the mini-invasive technique is still debated in many pediatric fields as the oncologic and the neonatal one, due to the characteristics of the pathologies, the technical difficulties and the absence of dedicated devices. In the last 20 years, many attempts have been made to further improve the established laparoscopic technique with the aim of minimize tissue trauma and the invasiveness of the procedure by reducing the size of trocars and instruments or the number of ports. Thus the “ultra”-minimally invasive surgical technique has been started, and significant technological advantages have been achieved as in the mini-laparoscopy, needlescopic surgery, Natural Orifice Transluminal Endoscopic Surgery (NOTES<sup>™</sup>) and single-site laparoscopy (SSL) [2,3]; some of these new technologies have been tested even in the pediatric population [4]. The use of minimally laparoscopic techniques is not widespread, particularly in the adult population, due to some limitations related to the instruments

themselves [5,6]; the same applies to NOTES<sup>™</sup> and SSL [7,8], which, due to some technical difficulties, are considered not suitable for all surgical procedures. A further evolution of mini-laparoscopy is represented by the development of the trocar-less percutaneous instruments [9] and the 3 mm trocar-less percutaneous instruments with interchangeable end-effectors designed to be assembled and disassembled in or outside the abdominal cavity [10–12]. The use of mini-laparoscopic technique is mandatory in the pediatric population, particularly in toddlers and in neonates, because of the limited size of the working space and viscera, even though the evolving research of dedicated devices is still necessary to achieve a true minimally invasive surgery. We report the first case of pediatric cholecystectomy performed with 2.3 mm percutaneous instruments (MiniLap<sup>®</sup> Percutaneous Surgical System, Teleflex Incorporated, USA) that represents a significant advance in minimally invasive surgery.

## 1. Case report

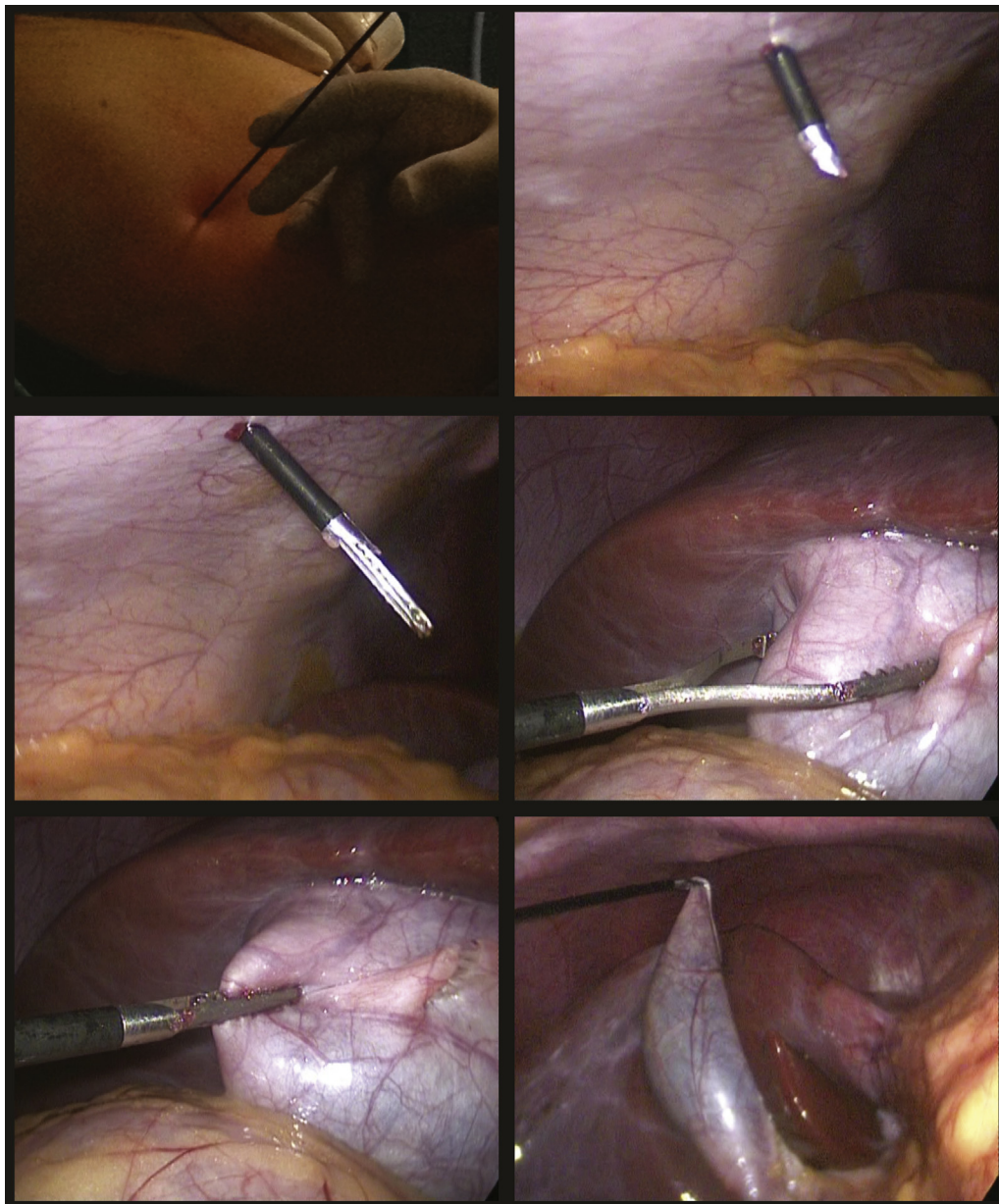
A 12-year-old female (BMI = 20) was referred to our center for recurrent abdominal pain; an US diagnosis of non-complicated gallstone was made and elective laparoscopic cholecystectomy was planned. Informed consent was obtained from the legal parents in accordance with the local legislation. Moreover, parents signed an informed consent to use images and videos of the procedure. The

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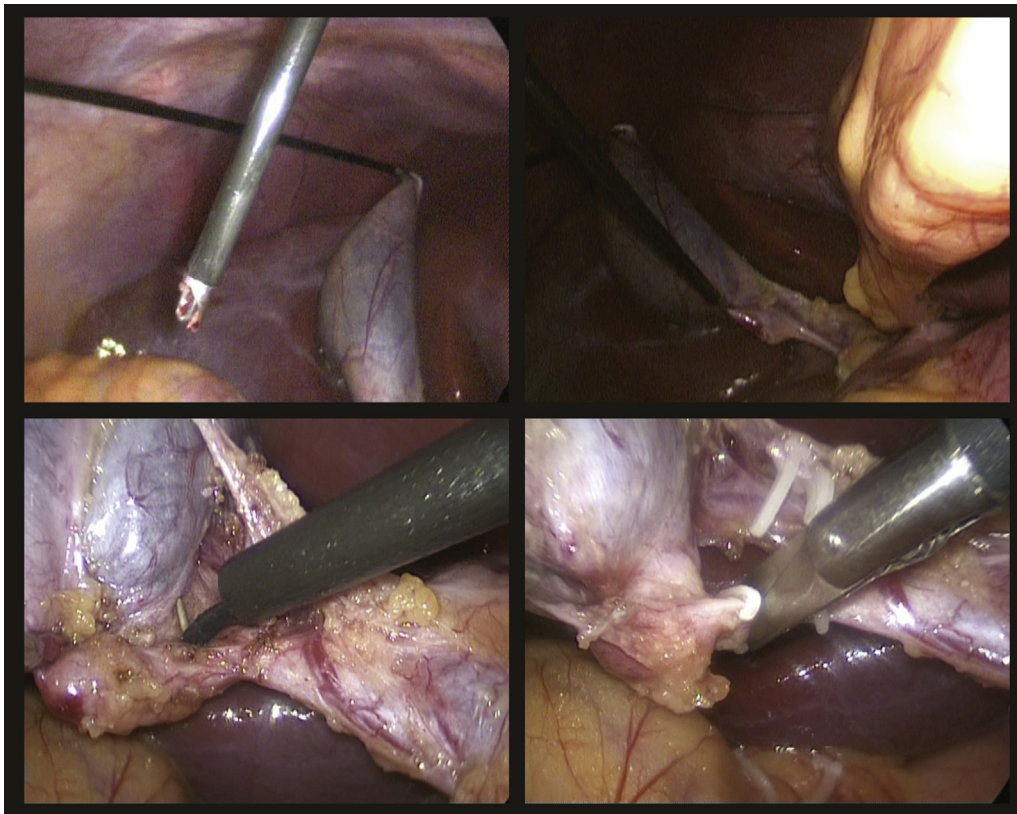
E-mail address: [vale.paradiso@gmail.com](mailto:vale.paradiso@gmail.com) (F.V. Paradiso).

patient was placed supine in the 30° reverse Trendelenburg position. The monitor was set on the right side of the patient, with the surgeon and the assistant standing on the left side. A 10-mm incision was made at the umbilicus and the pneumoperitoneum (13 mm Hg, 2 L/min) was achieved with the open technique. A 5-mm, 30° endoscope was used. Under visual control two 2.3-mm MiniLap® atraumatic graspers with integrated needle tip were percutaneously inserted into the abdomen through a small skin incision: one in the right flank and the other in the right mid-clavicular line, 20 mm below the costal margin. A 5-mm port was placed 20 mm inferior to the xiphoid for the 5-mm devices. The first atraumatic grasper was used by the assistant to stabilize the gallbladder and to lift it up in order to expose the operative field (Fig. 1). The second atraumatic MiniLap® grasper, in the left hand of the surgeon, was used to distend and expose the Calot triangle in order

to facilitate the dissection, that was carried out using the 5 mm hook cautery and Maryland dissector. After dissection both the cystic duct and artery were clipped with Weck® Hem-o-lok® system and cut (Fig. 2). The gallbladder was freed from its bed, put in a retrieval bag and extracted through the umbilical port hole. A drain was placed in the gallbladder lodge through the 5 mm access. Peritoneal desufflation through the ports was followed by closure of the fascia only in the umbilical port site by 0-0 Vycril (Ethicon). The umbilical skin was closed with absorbable intradermal suture; steri-strips were applied on the mini-laparoscopic instruments' access sites. The procedure was performed successfully with no intraoperative or postoperative complications. Operative time was 75 min overall. Postoperative analgesia was achieved with Paracetamol administered intravenously at the dose of 1 gr t.i.d. The drain was removed on day 1 and the patient was discharged on day



**Fig. 1.** A 2.3-mm shaft with a sharp retractable tip is inserted directly through the abdominal wall through a small skin incision; the device can then be deployed to grasp the gallbladder.



**Fig. 2.** Insertion of the second MiniLap<sup>®</sup> atraumatic grasper; exposure and dissection of the cystic duct and artery; the cystic artery has been clipped and cut; the cystic duct has been dissected and clipped.

2. No complications were evidenced at the first outpatient follow up 10 days after surgery.

## 2. Discussion

Mini-laparoscopy, or needlescopic surgery, was first described by Gagner et al., in 1998, and is defined as minimally invasive surgery performed with 3 mm or less instruments [13]. It is an emerging aspect of laparoscopic surgery, involving the use of miniaturized scopes and instruments aimed at reduce perioperative morbidity, enhance view and improve dexterity, without significantly increasing operative time, surgical effort, costs and, most important of all, without compromising the standards of surgical safety [14,15]. The improvements in instrument design and the development of trocar-less percutaneous systems are changing the mini-laparoscopy history; this is confirmed by the wide use of these devices in different surgical procedures [9,11]. Moreover, with the advent of the percutaneous system with interchangeable (3 mm–5 mm) end-effector, the combination of a 3-mm abdominal wall incision with a 5-mm instrument into the abdominal cavity has allowed to join the beneficial features of these two different sizes. In this respect, mini-laparoscopy exceeds other ultra mini-invasive laparoscopic techniques, such as NOTES<sup>™</sup> and SILS, allowing the surgeon to perform the surgical procedure as in a standard multiport surgery, thus maintaining the site of instrument insertion and avoiding the loss of triangulation. Moreover, the learning curve is not modified, and no patients selection is necessary; in fact it can be used even in obese patients [10–12].

When it comes to the pediatric population, the use of minimally invasive surgery is still debated; it represents an evolving

and crucial field mostly in neonates and infants. In the pediatric patient the use of mini-laparoscopy is mandatory, primarily for its physical features and for the limited intraoperative space, leading to a pressing and increasing technical demand for adequate devices [16]. The setting used in our procedure represents the first pediatric experience reported. Percutaneous MiniLap<sup>®</sup> instruments proved that the routine safety measures and the standard setting are preserved. The instruments have been easy to handle, and the patented design allowed an effective jaws opening as well as grasping of the gallbladder, avoiding any tearing or spillage of the distended structure. The steel shaft has provided a strong and firm retraction on tissues. The possibility to stabilize the jaws extracorporeally has prevented undesirable movements and, in each phase of the procedure, has allowed a firm traction with the distances and angles that we desired; moreover, any total device displacement was avoided. At present, the availability of traumatic and atraumatic graspers, and of different electrical coagulation devices could permit the extension of the MiniLap<sup>®</sup> use to other pediatric surgical procedures, particularly those in which a fix setting of the instruments is foreseen (e.g. orchiopexy for non palpable testis). Finally, the use of percutaneous instruments in the pediatric patients should prove comfortable mostly due to the elasticity of the abdominal wall, thus allowing less tissues' friction.

## 3. Conclusion

Pediatric percutaneous cholecystectomy is technically feasible and makes the minimally invasive surgery even less invasive. However, further studies are mandatory to define the



benefits, advantages and the cost-effectiveness of this approach compared to other minimally invasive techniques.

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