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ORIGINAL ARTICLE

Laparoscopic abdominal tumor resection: Further evidence for expanding on the current SIOP criteria based upon a Single Centre, Single Surgeon series of 28 children

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Abstract

Purpose: The purpose of the study was to evaluate the safety and feasibility of laparoscopic resection in paediatric patients with abdominal tumors. This is a retrospective observational study that focuses on a specific population of patients who underwent laparoscopic surgery for intra-abdominal solid malignancies in the department of paediatric surgery, All India Institute of Medical Sciences, New Delhi 110029, India. The results could help guide healthcare professionals in making informed decisions regarding the use of minimally invasive surgery (MIS) for diagnosing and treating abdominal tumors in children.

Methods: Total 28 children presenting with paediatric intra-abdominal tumors were included in which wilm's tumor (*n*=20), ganglioneuroblastoma (*n*=1) neuroblastoma (*n*=2), adrenal cortical tumor (*n*=2), ovarian tumor (*n*=2) and one patient had bilateral pheochromocytoma (*n*=1). Children were between 10 months-14 years (mean 46.6 months). A 3 or 4 port laparoscopic procedures were performed and lymph node sampling was carried out.

Results: The results of the study showed successful removal of the tumors in all cases, except for one instance of rupture. Specimens were retrieved through either a lumbar incision (*n*: 26 cases) or a Pfannenstiel incision (*n*: 2 cases). There were no conversions to open surgery. All the children underwent regular follow-up.

Conclusion: A laparoscopy or laparoscopic-assisted removal of paediatric intra-abdominal tumors is a safe and feasible option. This approach offers advantages such as reduced postoperative pain, shorter hospital stay, and better cosmetic results. The authors emphasized the importance of proper patient selection, appropriate port placement, and the surgeon's experience in laparoscopic techniques as contributing factors to successful outcomes. This report also provides further evidence to expand on the current SIOP criteria & support MIS in treatment protocols for tumors.

Key words: Laparoscopy; wilms; neuroblastoma; adrenal tumor; phaeochromocystoma; solid tumors; children; SIOP criteria

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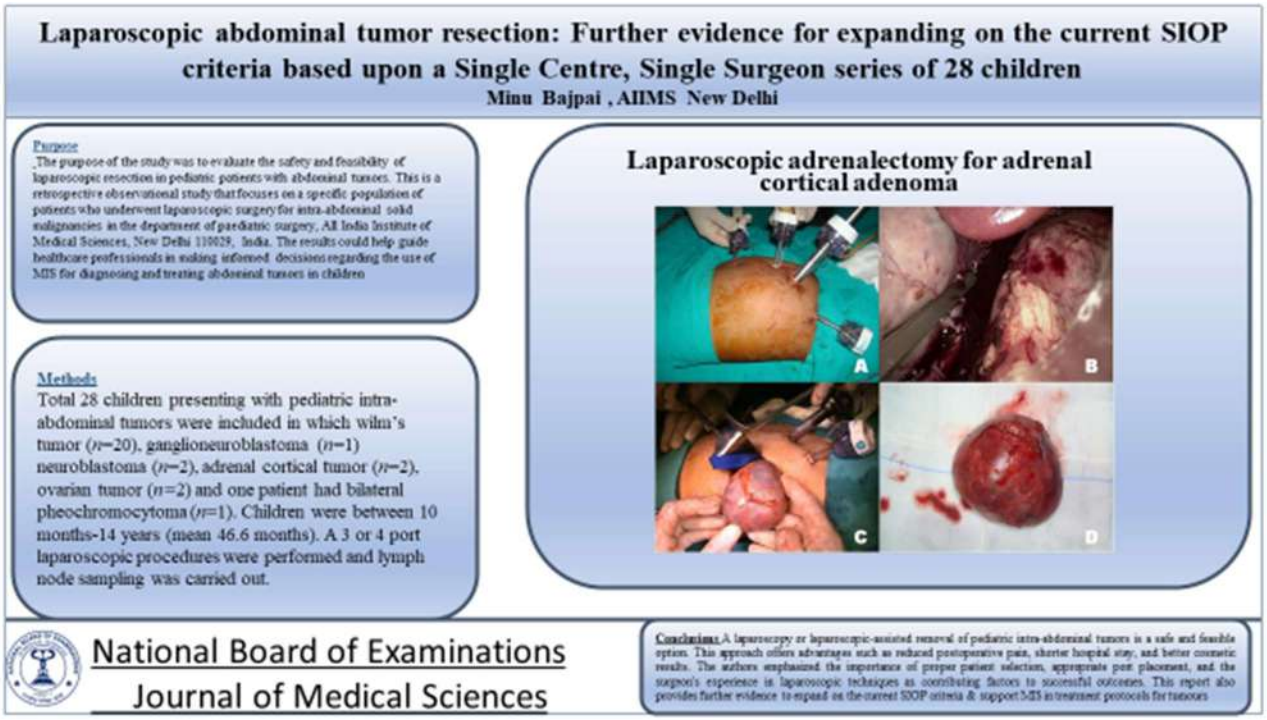
Graphical Abstract



Introduction

It is important to note that due to limited cancer registries and under-reporting in certain regions, the incidence of paediatric abdominal tumors in India may be underestimated. However, there are ongoing efforts to improve cancer surveillance and reporting in the country, which may lead to more accurate incidence estimates in the future. The paediatric abdominal tumors present diagnostic and technical challenges. Obtaining adequate tissue for diagnosis and treatment planning is crucial in these cases. Multiple diagnostic modalities, such as histologic, karyotypic, and molecular analyses, may be necessary to accurately diagnose these tumors. In certain situations, imaging studies may indicate that a tumor is unresectable at the time of diagnosis. However, obtaining a tissue sample for further analysis becomes essential in such cases. This is where laparoscopy, a minimally invasive surgical technique, can be beneficial in children with intraabdominal tumors.

Laparoscopy allows for a more precise visualization and access to the tumor site. It provides an opportunity to assess the tumor's size, location, and involvement with surrounding structures more accurately. The procedure involves making small incisions through laparoscope and other specialized surgical instruments are inserted into the abdomen. Compared to traditional open surgeries, laparoscopic procedures generally result in less post-operative pain, scarring, and shorter recovery times. These advantages are particularly important in paediatric patients, as it can minimize the physical and emotional stress associated with surgery.

Methodology

This is a retrospective observational study that focuses on a specific population of patients who underwent laparoscopic surgery for intra-abdominal solid malignancies during a certain period of time in the department of paediatric surgery at our institute. The study design involves reviewing past medical records and analyzing data to draw conclusions about the characteristics and outcomes of the patients.

One notable exclusion criterion in our study is patients who were not willing to participate. This exclusion could potentially introduce selection bias, as patients who declined to participate may have had different characteristics or outcomes compared to those who agreed to participate. It is important to note that retrospective studies are prone to several biases, and this should be taken into account when interpreting the results.

The established principles of oncology in the treatment of patients with solid intra-abdominal malignancies have been used. These principles involved a multidisciplinary approach to patient care, including the use of chemotherapy, imaging, and radiotherapy as per nationally accepted guidelines. A pre-operative ultrasound doppler was performed to assess for inferior vena cava (IVC) thrombus and involvement of adjacent organs. This non-invasive pathology test is an important part of the diagnostic workup for intra-abdominal malignancies, as it can help guide treatment decisions and surgical planning.

For instances that weren't invasive and didn't have an IVC thrombus or a distant metastasis, a laparoscopy was scheduled: All of the children were operated on by a single senior surgeon (MB), which could help ensure consistency in the surgical approach and potentially reduce variability in the outcomes. The study utilized a retrospective design, in which the admission records and follow-up files of the patients were assessed to gather data on the preoperative and post-operative characteristics of the patients. The use of retrospective data has advantages and disadvantages, as discussed earlier, but it can be a valuable way to analyze large amounts of information from past patient populations.

To ensure that the study was conducted in an ethical manner, parental consents were obtained, indicating that the parents of the children were made aware of the study and gave their permission for their child's medical records to be used. Additionally, we received an ethical waiver from the Institute's ethical committee, ensures that the committee reviewed the study proposal and determined that it posed minimal risks to patient confidentiality and privacy.

A laparoscopic procedure was performed under general anesthesia with the patient in a supine position, secured to the operating table with strapping. This allowed the surgeon to turn the tumor to optimal positions using gravity, which facilitated access to critical areas and reduced the risk of tumor rupture.

The laparoscopic excision of the tumor was performed using a three to four-port technique, which is a standard approach for laparoscopic surgeries. The technique was performed following the ergonomics of laparoscopy, which is important to reduce the risk of injury to the surgeon and the patient.

Tumor retrieval was performed through a near anatomical site incision, which is a common approach in laparoscopic surgeries. Lymph node sampling was performed under direct vision from a lumbotomy incision in cases of Wilms tumor and neuroblastoma. In addition, omental biopsy was taken in ovarian tumors if required. No drains were placed, and specimens were sent for histopathology examination. This is in line with the standard practice for laparoscopic surgeries, which typically do not require the use of drains or operative site washes. Post-operative pain was managed using intravenous or oral analgesics.

The demographic information of patient population included in the study

Total 28 children (17-males, 11-females) who presented to us with paediatric intraabdominal tumors were included. The tumors included Wilms tumor (n = 20), ganglioneuroblastoma (n = 1) neuroblastoma (n = 2), adrenal cortical tumor (n = 2), ovarian tumor (n = 2), bilateral pheochromocytoma (n = 1). Children were between 10 months–14 years (mean 46.6 months). A 3 or 4 port laparoscopic nephrectomy and lymph node sampling for Wilms tumor; adrenalectomy for adrenal tumors; and oophorectomy for ovarian tumor were performed. The case-wise distribution of the patients is presented in Table 1, which provides additional information about the types and locations of the tumors that were excised (Table 1).

Technique

Laparoscopic surgical procedures were performed under general anesthesia. The patients have been placed in the supine position, which means lying on their back. The patients were strapped to the operating table to ensure stability during the procedure. By using gravity, the tumors were turned to optimal positions, to improve access to critical areas without the need for excessive physical force. This approach also helps to avoid the risk of tumor rupture. A 3 to 4-port technique of laparoscopy have been employed for tumor excision. The ergonomics of laparoscopy have been followed to ensure optimal positioning and comfort for the surgical team. The tumors were retrieved through a small incision near the anatomical site where the tumors were located. In cases of Wilms tumor and neuroblastoma, lymph node sampling was performed. This has been done under direct vision from a lumbotomy incision, which is an incision made in the lower back area [1]. An omental biopsy have been taken in cases involving ovarian tumors. No drains were placed, as we did not deem it necessary to insert drainage tubes after the procedure. The excised tumors and other relevant tissues have been sent for histopathology examination to determine the nature and characteristics of the tissues. No washes have been given at the operative site. No additional cleaning or irrigation has been performed at the surgical site after the procedure. Pain after the surgeries has been managed using intravenous and oral analgesics.

With the exception of one, none of the tumors ruptured during removal. Through lumbar incisions (n = 20) and Pfanninsteil incisions (n = 8), specimens were removed. Open surgery was not performed in any cases. All of the kids are regularly monitored. Local recurrence of a Wilms tumor occurred

in one child. One child needed a port tract excision due to a port-site recurrence. One had open surgery for recurrence after neuroblastoma in a youngster. There were no deaths in this study group.

Table 1. Distribution of cases

S. No.	Histological Diagnosis	Age at Surgery (Months)	Gender	Site (Left, Right or Bilateral)	Stage	Pre-operative Chemotherapy	Pre-operative Tumor Volume (cm^3)	Complication
1.	Wilm's Tumor	52	Male	Left	III	Yes	1500	No
2.	Wilm's Tumor	24	Male	Right	III	Yes	528	No
3.	Wilm's Tumor	28	Female	Left	III	Yes	1170	No
4.	Wilm's Tumor	10	Female	Left	III	Yes	432	No
5.	Wilm's Tumor	31	Male	Left	III	Yes	1560	No
6.	Wilm's Tumor	68	Male	Right	III	Yes	936	No
7.	Wilm's Tumor	33	Male	Right	III	Yes	1040	Port site recurrence
8.	Wilm's Tumor	41	Female	Left	III	Yes	1320	No
9.	Wilm's Tumor	36	Male	Right	III	Yes	1040	No
10.	Wilm's Tumor	48	Male	Left	III	Yes	640	No
11.	Wilm's Tumor	27	Male	Left	III	Yes	1320	Pre-rupture and post-operative recurrence
12.	Wilm's Tumor	21	Female	Right	III	Yes	960	No
13.	Wilm's Tumor	32	Male	Left	III	Yes	1440	No
14.	Wilm's Tumor	33	Female	Right	III	Yes	1160	No
15. *	Wilm's Tumor	60	Male	Left	III		1560	Port-site recurrence
16.	Wilm's Tumor	24	Male	Left	III	Yes	1140	No
17.	Wilm's Tumor	41	Female	Right	III	Yes	1070	No
18.	Wilm's Tumor	27	Male	Left	III	Yes	970	Surgical site infection
19.	Wilm's Tumor	48	Male	Left	III	Yes	1090	No
20.	Wilm's Tumor	45	Male	Right	III	Yes	1120	No
21.	Ganglioneuroblastoma	36	Male	Right	II	Yes	384	No
22.	Neuroblastoma	40	Female		II	Yes	294	No
23.	Neuroblastoma	44	Male	Right	II	Yes	315	Local recurrence
24.	Immature ovarian teratoma	64	Female	Right	N/A	No	792	No
25.	Yolk sac ovarian tumor	170	Female	Left	I	Yes	792	No
26.	Adrenal cortical carcinoma	36	Male	Right	II	No	120	No
27.	Adrenal cortical adenoma	42	Female	Right	II	No	200	No
28.	Pheochromocytoma	144	Female	Bilateral	II	No	100/120	No

* WAGR syndrome: Wilms tumor, aniridia, genitourinary anomalies, mental retardation syndrome.

All patients with Wilms tumor, neuroblastoma, and ovarian tumor received pre-operative chemotherapy to shrink the size of the tumors and better define the margins of the lesions, which could make them easier to remove during surgery. The patients were selected on the basis specific criteria. Specifically, all cases were resectable on cross-sectional imaging with a well-defined plane of dissection and no inferior vena cava (IVC) thrombus or distant metastasis. This means that the tumors were deemed to be operable and able to be removed through laparoscopic excision. Before the laparoscopic procedure, the parents underwent a thorough consultation with the anesthesia team to ensure that they were fit for surgery and to plan the anesthesia approach that would be used during the laparoscopic procedure. These patients were initially considered non-resectable due to the large size of the tumor at presentation and were given chemotherapy before surgery. They were classified as having NWTS tumor stage–I (n = 1), stage–II (n = 3) and stage–III (n = 23) and no staging in 1 patient. The patients with neuroblastoma had right-sided tumors and were classified as having INRG-SS L2 stage. They received chemotherapy and were operated on after 18 weeks of treatment.

Adrenal cortical adenoma is a benign tumor of the adrenal gland that produces excess hormones, while adrenocortical carcinoma is a malignant tumor that can also produce excess hormones. In the case series, the adrenal cortical adenoma was detected incidentally for unrelated abdominal pain, while the adrenocortical carcinoma presented with excessive hair growth and hoarse cry. No chemotherapy was given for these tumors, and they were operated on at 42 and 36 months of age, respectively. The patient with bilateral pheochromocytoma had her blood pressure well-controlled with alpha-blockers and beta-blockers in the pre-operative period. Pheochromocytomas are rare tumors that secrete catecholamines, which can cause episodes of hypertension, sweating, and palpitations. It's important to control blood pressure prior to surgery, as manipulation of the tumor during surgery can cause sudden release of catecholamines leading to hypertensive crisis. The use of alpha-blockers and beta-blockers is the standard treatment for such cases. The pre-operative imaging determine the size and location of the tumors. In the situations of Wilms tumor and neuroblastoma, pre-operative cytology has been used to make a diagnosis. However, for ovarian and other adrenal tumors there was no pre-operative tissue collection done (Table 1).

The Pfannenstiel incision was used for ovarian tumors, which is a common approach for gynecologic surgeries. It has been assured that there was minimal intraoperative blood loss and no need for blood transfusion. The tumor retrieval bagsfor pheochromocytoma and adrenal cortical tumors has been used to prevent the spread of potentially malignant cells during the surgery.

Lymph node sampling has been done as it is an important aspect of the surgical management of many malignancies, as it helps to determine the extent of disease and guide further treatment decisions. In our case series, the extended lumbotomy incision has been utilized to provide good exposure to the

tumor bed and enable lymph node sampling. This approach was successful in all cases of Wilms tumor and one case of neuroblastoma, with a range of 3 to 7 lymph nodes retrieved. Additionally, in one case of ovarian tumor, omental biopsy was required due to dense adhesion of the ovarian mass to the omentum. This highlights the importance of thorough intraoperative assessment and the potential need for additional procedures to ensure complete resection of the tumor and accurate staging.

The patients with Wilm's and neurblastoma tumor were positioned in a supine position with a roll placed beneath the affected side to elevate the patients by up to 20 degrees. The patients were securely strapped to the operation table. Different table-tilting positions could be safely achieved during the procedure, which were particularly helpful in dissecting very large tumors.

The surgical technique used a standard three- to four-port approach for tumor resection. A 12mm camera port and 12 or 5mm working ports were used. The camera port was consistently inserted through the umbilicus in all cases.

The initial assessment of the tumor confirmed its extent and verified that it did not infiltrate nearby structures. To expose the tumor limits, either the right or left colon was displaced medially. Dissections were performed using a Harmonic scalpel or an electrocautery hook. A blunt metallic suction cannulas were used to lift the tumor and create a fulcrum against the posterior abdominal wall. This maneuver helped improve accessibility and control of the hilar vessels, especially in cases where the tumor overhung and obstructed the hilum.

The tumors were dissected along all its borders using the Harmonic scalpel, and vascular clips were applied for closure of the hilar vessels before division. The specimens were secured in a retrieval bag, and both specimen retrieval and lymph node sampling were performed through an extended lumbotomy incision. Typically, a lumbotomy incision is made transversely, 1 cm below the 12th rib, starting from the medial edge of the erector spinae and extending laterally by 4–5 cm. However, for larger tumors, these incisions were extended anteriorly by a few additional centimeters, creating an extended lumbotomy incision. Figures 1–3 accompany the text to provide visual representations of the described techniques and incision sites.

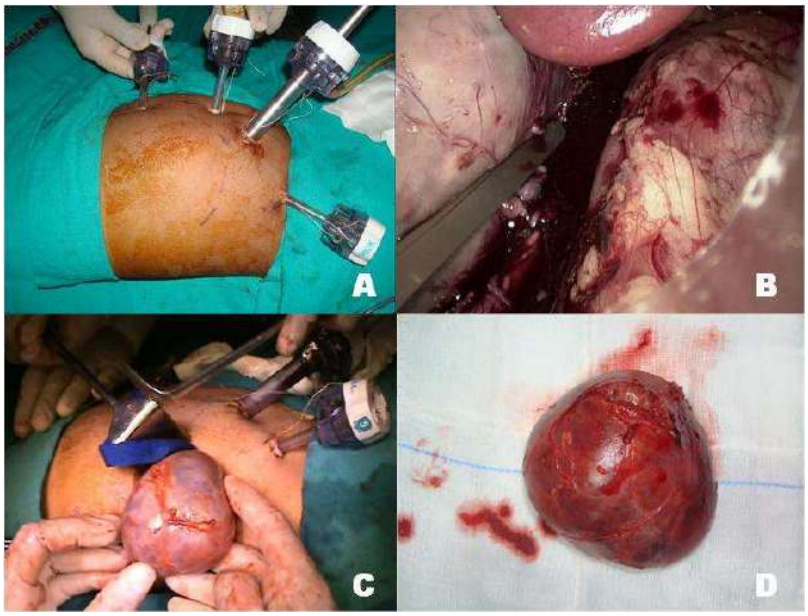


Figure 1 **(A-D)**. Laparoscopic adrenalectomy for adrenal cortical adenoma. **A.** Port placement; **B.** Intraoperative; **C.** Lumboscopic incision; **D.** Tumor

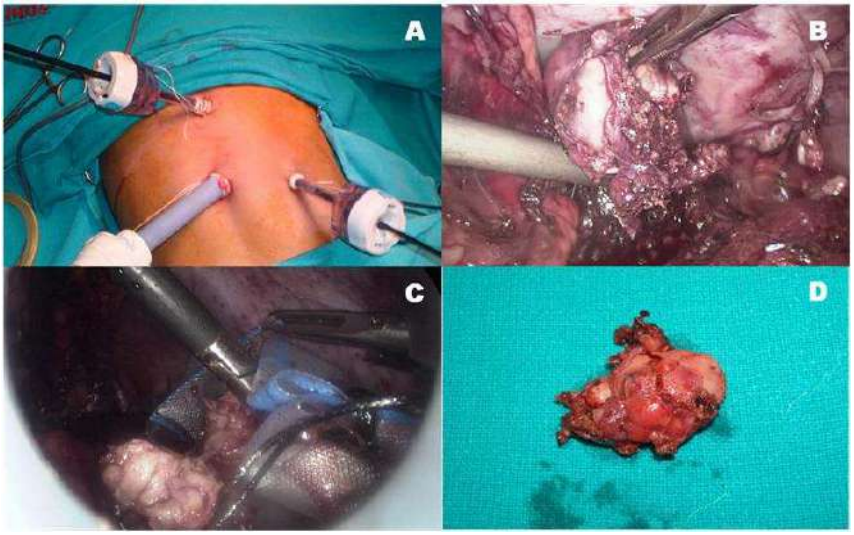


Figure 2. (**A-D**). Laparascopic approach for neuroblastoma. **A.** Port placement; **B.** Intraoprative; **C.** Tumor retrieval; **D.** Tumor

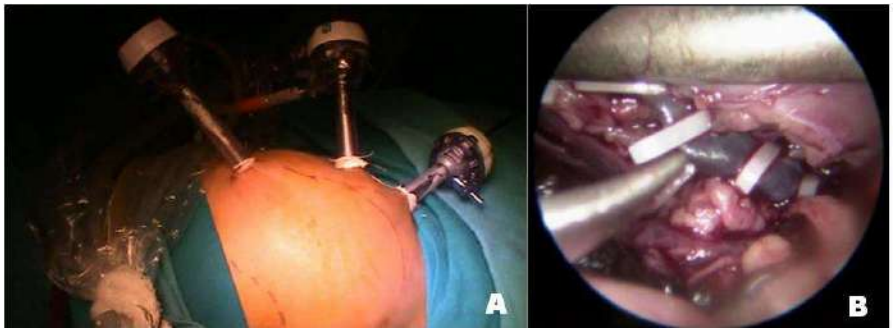


Figure 3. (**A-B**). Laparoscopic nephrectomy for Wilms tumor. **A.** Port placement; **B.** Vascular clipping.

Our patients have been provided with oral intake shortly after surgery and that post-operative chemotherapy was started before discharge and continued according to the protocol. The mean hospital stay of 5.6 ± 1.6 post-operative days is also a positive outcome. The patient with pre-operative tumor rupture experienced a recurrence after surgery despite receiving radiotherapy and chemotherapy. It is important to closely monitor and manage such cases with advanced chemotherapy. Similarly, the case of neuroblastoma with local recurrence highlights the importance of close follow-up and early intervention in case of recurrence. Patient is doing well after the re-exploration surgery.

The immature ovarian teratoma, adrenal cortical tumors, and pheochromocytoma were successfully managed with surgery alone without the need for adjuvant therapy. However, it is concerning to hear about the cases of local recurrence, particularly in the patient with pre-operative tumor rupture and the case of neuroblastoma. It is important for these patients to receive appropriate management and follow-up to ensure the best possible outcome. The patients have been successfully treated and are being closely monitored for any potential recurrence or complications. Regular follow-up is crucial to ensure the ongoing health and well-being of these patients.

Discussion

Laparoscopic surgery, also known as minimally invasive surgery, involves making small incisions in the abdomen and inserting a thin, flexible tube with a camera and surgical instruments attached. This approach allows for less tissue trauma, shorter hospital stays, and faster recovery times compared to traditional open surgery. The use of laparoscopy in paediatric surgery began in the 1990s, and its use in the management of paediatric abdominal tumors has increased over the years. The first reported laparoscopic excision of a paediatric abdominal tumor was in 1991, when a 3-year-old boy underwent laparoscopic removal of a Wilms tumor [2].

Since then, several studies have reported the successful use of laparoscopy in the management of a variety of paediatric abdominal tumors, including neuroblastomas, hepatoblastomas, and ovarian tumors. In particular, laparoscopic surgery has become the preferred approach for the treatment of ovarian tumors in children, as it offers excellent visualization and allows for complete excision of the tumor while preserving ovarian function.

Benign mature ovarian teratoma is indeed the most common ovarian tumor in children and typically requires surgical management [3,4]. However, performing a unilateral oophorectomy (removal of one ovary) at a young age can potentially lead to a shorter reproductive life span and early onset of menopause [5]. To preserve future fertility, it has been recommended that ovarian sparing surgery (removal of the tumor while preserving the ovary) should be the primary surgical procedure for the treatment of benign ovarian tumors in children [6].

Laparoscopy provides a wider field of vision and enhanced magnification, which can help paediatric surgeons to mobilize and

dissect tumors with greater precision and minimal injury to adjacent structures. This can be especially important in the management of complex tumors or tumors that are located close to vital organs or blood vessels.

In addition, laparoscopic surgery can benefit from advanced energy sources such as the Harmonic scalpel and Ligasure, which can help to release adhesions and provide better control of intraoperative bleeding. These tools use advanced energy technology to cut and coagulate tissue, minimizing bleeding and tissue trauma and facilitating faster and safer surgical procedures. Neoadjuvant chemotherapy has been shown to be effective in reducing the size of paediatric abdominal tumors and forming a pseudo-capsule, which can make the tumor more amenable to resection and minimize the risk of rupture during surgery. Many studies have supported the use of neoadjuvant chemotherapy in the management of paediatric abdominal tumors, including Wilms tumor.

While there have been some case reports suggesting the feasibility of laparoscopic nephrectomy as an upfront surgery for Wilms tumor and cases with lung and peritoneal metastasis [7,8]. We not currently promote minimally invasive surgery (MIS) for upfront laparoscopic surgery in such cases. However, we anticipate that laparoscopy may play a role in the management of advanced and metastatic disease in the future. The selection of surgical approach and treatment plan should be individualized based on the specific characteristics of each patient's tumor and overall health status, and should be made in consultation with a multidisciplinary team of paediatric oncologists, surgeons, and other specialists.

The laparoscopy can be a valuable tool in the management of large and advanced-stage paediatric abdominal tumors. In some cases, the size of the tumor may initially seem like a limitation for laparoscopic resection, but in practice, laparoscopy can often provide excellent access to the tumor and surrounding structures, allowing for selective dissection and ligation of the hilar vessels.

In our patients, pre-operative chemotherapy helps to reduce the size of the tumor and make it more amenable to laparoscopic resection. However, even in cases where the tumor remains bulky after chemotherapy, laparoscopy still is a useful approach, particularly when combined with advanced energy sources and other surgical techniques.

In any case, it is essential to follow oncologic principles during laparoscopic resection of paediatric abdominal tumors, including complete tumor resection and lymph node sampling. With careful planning and execution, laparoscopy can provide a safe and effective alternative to open surgical approaches, with the added benefits of reduced morbidity and faster recovery for young patients. A laparotomy scar can be a visible reminder of a patient's disease, and in some cases, laparoscopy provides a more cosmetically acceptable alternative. In the case of paediatric abdominal tumors, laparoscopy may be particularly useful for minimizing visible scarring in young patients who are still developing body image and self-esteem. For tumor retrieval during

laparoscopic procedures, there are several different approaches that can be used, including Pfannenstiel and umbilical incisions. However, the use of an incision close to the tumor bed may be preferred in some cases, particularly for renal and adrenal tumors. In this series, we have reported using a lumbotomy incision for tumor retrieval in most cases, while reserving a muscle-splitting Pfannenstiel incision for ovarian masses.

The choice of incision site and approach should be tailored to the specific characteristics of each patient's tumor and the overall goals of the procedure. In some cases, the use of multiple incisions may be necessary to provide optimal access and visualization during laparoscopic resection. The extended lumbotomy incision appears to offer several advantages over the classical transverse abdominal incision and the Pfannenstiel incision for paediatric abdominal tumor resection. One advantage is the limited size of the incision, which reduces the risk of complications and allows for quicker recovery. Additionally, the direct inspection of the tumor bed and tactile assessment can facilitate more precise and complete tumor resection.

Another advantage of the extended lumbotomy incision is the ability to perform berry picking of the lymph nodes. This technique involves identifying and removing lymph nodes that are directly adjacent to the tumor, which can help to prevent the spread of cancer cells and improve overall oncologic outcomes.

The posterolateral position of the scar also offers a psychological advantage by reducing the visibility of the scar and potentially alleviating anxiety in young patients. Moreover, taking out the tumor through the ipsilateral lumbotomy incision is safer than the distant Pfannensteil incision, as it reduces the risk of tumor seeding throughout the abdominal cavity.

Finally, the use of the extended lumbotomy incision can help to ensure that lymph node sampling is performed in accordance with oncologic principles. In contrast, the classical use of the Pfannenstiel incision can lead to a complete loss of pneumoperitoneum after specimen retrieval, limiting the ability to perform lymph node sampling for upper abdominal tumors and compromising oncologic outcomes. The extended lumbotomy incision provides several advantages, including direct inspection of the tumor bed with its tactile assessment, berry picking of the lymph nodes, and minimizing tumor seeding. Additionally, it allows for the retrieval of the tumor through an incision close to the tumor bed, reducing the risk of tumor seeding in the entire abdominal cavity. This approach also facilitates lymph node sampling from the tumor bed under direct vision, even after the loss of pneumoperitoneum, thus optimizing oncologic principles. Furthermore, the use of an ipsilateral lumbotomy incision confines the incision for tumor removal to the vicinity of the tumor and optimizes the field of radiation, if the same therapy is required, whereas a Pfannensteil incision would have required extended radiotherapy to a more distant region or whole abdomen radiation.

It is important to note that the incidence of port site recurrence after laparoscopic surgery in paediatric tumors is still not well-documented due to limited

follow-up literature. However, studies in adults with urothelial cancers have reported a low incidence of port site recurrence at 0.12% [9]. In the present case series, we have reported one case of port site recurrence which was managed successfully by excision of the port tract without any further recurrence. Nonetheless, it is important to closely monitor patients for any signs of recurrence or complications following laparoscopic surgery. The use of laparoscopy in neuroblastoma cases may be more limited in our setup due to the late presentation of cases, and the concerns regarding ovarian tumors have been addressed by limiting the use of MIS to smaller tumors and performing ovarian sparing procedures when possible. The MIS has also been explored for nephron sparing renal surgery, hepatic resection, pancreatic tumors, and sacrococcygeal masses, and that single-port surgeries and robotics may be future prospects in paediatric malignancies [10].

The optimal approach to tumor resection in paediatric malignancies is still a matter of debate and may vary depending on several factors, including the type, stage, and location of the tumor, as well as the surgeon's experience and preference. While laparoscopic approaches have been shown to offer certain advantages over open surgery, such as less pain, shorter hospital stays, and quicker recovery times, they may not always be feasible or appropriate in certain cases. As for the Cochrane review mentioned, it is important to keep in mind that the results of meta-analyses and systematic reviews may be limited by the quality and heterogeneity of the included studies, as well as other biases and confounding factors. Therefore, it is difficult to draw definitive conclusions about the comparative effectiveness and safety of different surgical approaches based on these types of reviews alone [11].

Lymph node sampling can be feasible with near-anatomical site incision approach. It's important to ensure adequate lymph node sampling for accurate staging and management of solid tumors. The role of MIS in paediatric malignancies is still a topic of debate and further research is needed to determine its safety and efficacy compared to traditional open surgery. While there are some reports of successful laparoscopic resections in certain cases, such as neuroblastoma and ovarian tumors with small diameter, concerns regarding the risk of incomplete resection and inadequate lymph node sampling still exist. However, with the development of newer technologies such as single-port surgeries and robotics, there may be potential for future implementation of MIS in paediatric malignancies [12].

Laparoscopy in paediatric solid tumors: Further evidence on a successful technique

An increasing number of paediatric cancer patients are undergoing minimally invasive surgery [13]. It is used for laparoscopic biopsies, tumor extent diagnosis, second opinions, as well as the total removal of tumors. Even though laparoscopy now has a limited function in tumor resection surgery, there are an increasing number of papers that support laparoscopic tumor resection [14-16]. The preliminary data do not point to a port-site recurrence of cancer, even if the investigations were not conducted over a long period of time or for a large number of patients [17].

Laparoscopy in Wilms' Tumor

Minimally invasive surgery (MIS) in the paediatric patients with cancers is gaining popularity. MIS is currently utilized for biopsies, assessment of tumor extent, second-look, as well as tumor exterpation. Though, only limited reports are available on experience with laparoscopy, increasing information is now available which favours successful laparoscopic tumor resection. Few long term reports on large group of patients are available but, at least, the preliminary reports are not indicative of higher risk of port-site recurrence of malignancy.

Due to a lack of accrual, a multi-institutional prospective randomised controlled study that intended to assess the function of MIS in children with paediatric malignancies was prematurely closed in 1998 [18].

A review of the causes that led to its termination revealed that nearly 40% of the surgeons weren't actively using MIS at their centres. Experts from all across the world drew attention to various controversies in the years that followed. These included inquiries into the appropriateness of lymph node sampling, the state of the surgical margins and GTR (gross total resection), the removal of big tumors, and other issues [19-21].

The SIOP Renal Tumor Study Group has also emphasised the inadequacy of lymph node sampling with the MIS technique [10]. The group has drawn comparisons between methods used with the MIS and open approaches. The excision of big tumors and sufficient lymph node sampling, however, continue to be the key issues [10]. There is insufficient evidence to justify MIS for paediatric renal tumors, according to a systematic review conducted by the American Paediatric Surgery Association (APSA) Cancer Committee [22]. Inadequate lymph node collection and a higher risk of intraoperative leak during MIS were the committee's top two concerns.

In an earlier report the author (MB) has addressed both these issue, i.e., successful excision of large tmours and adequacy of lymph node sampling by laparoscopy, utilizing appropriate techniques [23–24].

While there is currently no standard selection criteria for laparoscopic tumor excision in paediatric malignancies, the decision to use minimally invasive surgery should be made by a team of specialists including a paediatric surgeon, paediatric oncologist, and radiologist based on the individual patient's case and clinical characteristics. The surgeon's experience and knowledge are important factors in this decision-making process, but should not be the sole determining factors. The benefits and risks of laparoscopic surgery compared to open surgery should be carefully considered and discussed with the patient and family to make an informed decision.

It is important to note that while laparoscopy has shown promise in paediatric malignancies, its implementation should be carefully considered and performed by experienced surgeons. Further studies with longer follow-up periods and controlled trials are needed to evaluate the long-term outcomes and efficacy of laparoscopy in comparison to open surgery for solid malignancies. As the technology and techniques for laparoscopy continue to improve, its integration into future treatment protocols should be considered.

Conclusion

Lymph node sampling can also be performed effectively with laparoscopy. However, longer follow-up and multi-institutional controlled trials are needed to evaluate the long-term outcomes and to compare open versus laparoscopic surgery for solid tumors. Additionally, only surgeons with more experience in both paediatric oncology and laparoscopic surgery should perform the initial adoption of MIS in paediatric malignancies. The incorporation of laparoscopy in upcoming treatment protocols is encouraged given the advancements in laparoscopy and its careful application in paediatric cancers.

Conflicts of interest

The author declares that they do not have conflict of interest.

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