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Applications of laparoscopic surgery in treating ovarian tumors in children

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Summary

Purpose: This study aims to investigate the values of laparoscopic surgery in treating ovarian tumors in children. *Materials and Methods:* A total of 51 pediatric patients with ovarian tumors were enrolled, and all the patients were treated using laparoscopic surgery, including 48 cases of ovarian tumorectomy for benign tumors and three cases of unilateral adnexectomy for prophase germinoma; the operation time, average postoperative hospital stay, tumor recurrence, and growth and development of the patients were followed up. *Results:* All the patients were successfully underwent laparoscopic surgery, among which six cases had an ovarian cyst pedicle torsion, but with restored good ovarian blood supply. The mean operation time was 40 ± 15 minutes, and the average postoperative hospital stay was 3 ± 1 days. Follow-up was performed for si months to seven years, and the three cases of prophase germinoma were followed up for two to five years; no evidence of tumor recurrence was observed, and no growth abnormality occurred. *Conclusions:* Laparoscopic surgery for ovarian tumors in children has less damages, rapid postoperative recovery, and fewer complications, therefore it is safe and effective.

Key words: Ovarian tumor; Laparoscopic surgery; Children.

Introduction

Ovarian tumors can occur in women at any ages [1], and are the leading causes of death of all gynecologic tumors [2]; however, the incidence, histologic distribution, and clinical manifestations in pediatric populations are distinct from those in adults [3]. In fact, ovarian tumors are very uncommon in children representing a very small proportion of all ovarian tumors [4], which constitutes 2.8% of total ovarian tumors in the age group 0-14 years (<15 years) of age [5]. Functional cysts, ovarian torsion, and benign neoplasms are the most common ovarian masses in young adolescents [6], and mature cystic teratoma remains the single most common childhood ovarian neoplasm [7], and malignant ovarian tumors in childhood are extremely rare and far less common than benign ovarian tumors [8].

Preservation of gonadal function is an important priority for the long-term health of cancer survivors of both sexes and all ages at treatment [9, 10]. Among female children, many conditions can lead to impaired fertility, so fertility preservation should be considered in girls facing gonadotoxic treatments [11]. It has been demonstrated that benign ovarian lesions in children can be treated successfully with ovarian sparing surgery with low recurrence and reoperation rates [12].

Traditional treatment methods include open surgery, which results in a large incision and slow postoperative recovery, so it will significantly impact the physical and mental health of the children; furthermore, it may cause adverse effects to the reproductive functions in children in the future. With the development of laparoscopic techniques, it has become possible to use minimally invasive laparoscopic surgery for the treatment of ovarian tumors in children [13, 14], especially for smaller tumors, the incision can be minimal, the surgery can be quick, and the injuries can also be minimal; hence it will be more easily accepted by the children. From July 2006 to July 2016, the authors used laparoscopic surgery to treat a total of 51 children with ovarian tumors, and achieved satisfactory clinical efficacies which is now reported below.

Materials and Methods

The enrolled 51 pediatric patients aged three to 14 years, with an average as 11 years and five months; 22 cases had menstruation (the average age was 12.5 years). The main clinical manifestations were abdominal mass (64.7%, 33/51), abdominal pain (50.9%, 26/51), abdominal distension (17.7%, 9/51), and precocious puberty (4%, 2/51). All the cases \underwent abdominal and pelvic ultrasound, reproductive hormone inspection, and tumor marker inspection; nine cases had pelvic CT scanning, and eight cases had an MRI. Imaging studies suggested pelvic lesions. Ten cases exhibited tumor diameter < 3 cm, 26 cases exhibited tumor diameter within 3~5 cm, and 15 cases exhibited tumor diameter more than five cm. Five cases exhibited slightly increased cancer antigen 125 (CA125), ranging within 36~61 IU/L; two cases exhibited positive serum alpha-fetoprotein (AFP), and two cases exhibited increased follicle stimulating hormone (FSH), luteinizing

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hormone (LH), and estradiol (E2). Seven cases underwent emergency surgery, and the remaining 44 cases underwent elective surgery. Patients with early ovarian tumor (diameter >10 cm) and advanced ovarian tumor were excluded. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Zhejiang Provincial People's Hospital and written informed consent was obtained from all participants' guardians.

After tracheal intubation and intravenous complex anesthesia were performed, each patient was placed in the improved plane bladder lithotomy position. After disinfection, urethral catheterization was performed, and paved sterile towels where positioned, each patient was changed to the horizontal position, and directly punctured using one five-mm Trocar from the umbilical hole; CO_2 was filled in order to maintain a pressure increase of 10 mmHg; one five-mm laparoscope was then introduced into. After the position was changed to the Trendelenburg position, one ten-mm Trocar was punctured into the left lower quadrant under laparoscopic monitoring, and another five-mm Trocar was punctured into the right lower quadrant in order to comprehensively explore the pelvic status, including pelvic adhesions, effusions, malignant metastatic nodules, tumor perforation, ovarian or appendant torsion or necrosis, etc. The exploration results were used to decide the surgical protocol: simple ovarian tumorectomy: one Satinsky's clamp was used to clamp the pelvic funnel ligaments; after lifting the ipsilateral ovary, one separation clamp clipped the ovarian cortex, which was then incised using one separation scissors until the tumor wall. The tumor was then bluntly isolated and dissected along the sac wall. The incised tumor was temporarily not removed, which was placed into the uterorectal lacuna if the tumor volume was smaller or into the right iliac fossa if the tumor volume was larger. The ovarian wound underwent firstly proper hemostasis, and then one 3-0 absorbable suture was used to suture the ovarian tissue. If the ovarian torsion had occurred, it was firstly reset, and its blood supply recovery was observed. If the blood supply was good, the tumor was then removed; if ovarian necrosis was confirmed, oophorosalpingectomy of the lesioned side was then performed. If the benign tumor had large volume, it was firstly punctured and partial cystic fluid was suctioned, followed by ligating the puncture site and resecting the cyst. With regards to the tumor with smaller diameter, oophorosalpingectomy was directly performed on the lesioned site, and the sample was then rapidly cryopreserved for pathological evacuation. If it was confirmed as malignant, comprehensive staging exploration was planned. The resected tumor or accessories were placed into specimen bags and then removed through the left lower quadrant puncture hole. After the surgery, CO_2 was released, followed by withdrawing the laparoscope and operating instruments, as well as conventionally suturing the incision. With regards to large ovarian tumor, if it was suspected as malignant intraoperatively, the laparoscopic surgery was converted to open surgery for tumor resection.

All the data were analyzed using SPSS18.0 software package, and the measurement data were expressed as mean ± standard deviation (±s).

Results

All the patients exhibited intraoperative stable vital signs, together with oxygen saturation, CO_2 partial pressure, and airway pressure fluctuating within normal ranges. All the operations were successfully completed under laparoscope, and no case was converted to open surgery. The operation time ranged within 20~70 minutes, with an average of 40 minutes. Forty-eight cases of tumorectomy were performed, including 23 cases on the right side, 17 cases on the left side, and eight cases on bilateral sides; no case of ovarian tumor rupture occurred. A total of seven cases of ovarian pedicle torsion occurred (all were the cases with teratoma), and six cases underwent emergency surgery. The degrees of ovarian torsion ranged from 90-360°; after the reduction, the ovary blood supply was good, and then the tumors were resected. Three cases had an adnexectomy, which was identified as phase Ia malignant germinocarcinoma, and the tumor diameters ranged from 5~10 cm. Intraoperative comprehensive laparoscopic exploration found no evidence of abdominopelvic metastasis, therefore no case had an expansion of the operation scope after combining with preoperative and imaging data intraoperative parents' opinions.

Each patient was sent back to the ward after recovered from anesthesia, and five cases reported postoperative wound pain, but no analgesic drug was used as pain was tolerated. Nine cases had sub-rib or shoulder pain, and three cases had subcutaneous emphysema, but gradually disappeared three days later. Six hours after surgery, the catheter was removed for patient's self-urination. Flatus occurred 12~24 hours after the surgery. No postoperative infection and complication appeared, and abdominal wounds healed well. The mean postoperative hospital stay was three days.

This study included 11 benign tumor cases, originating from coelomic epithelium (seven cases of serous cystadenoma, three cases of mucinous cystadenoma, and one case of mixed cystadenoma, accounting for 18%); 31 cases of germinocarcinoma (28 cases of mature teratoma, two cases of yolk sac tumor, and one case of asexual cell tumor, accounting for 68%; six cases of tumor-like lesions, and there were three cases of ovarian endometriosis. The two cases with yolk sac tumor were prescribed BEP chemotherapy two weeks after surgery for four to six courses. Forty-five cases were followed up for six months to seven years, and six patients were lost. There is no evidence of tumor recurrence until now, and the height, weight, intellectual development, and menstrual situation of the children are similar to normal children with the same age, and with no growth abnormality occurring.

Discussion

Ovarian tumors in children are uncommon, but the most common among genital tumors in this age group, although the exact incidence rate is not clear yet [15]. The pathological types are mainly benign, among which teratoma is more common, accounting for more than 50%, mostly occurs unilaterally on the right side; malignant ovarian tumors are rare [16], among which malignant prophase germinocarcinoma is more common [16-18]. The pathological data of the 38 patients in this study were consistent

with those reported in China and abroad. Ovarian tumors in children may be asymptomatic, and abdominal pain is the most common complaint in young patients with adnexal masses [19], together with nausea, vomiting, other gastrointestinal reactions, or sexual precocity [20, 21]. The main clinical manifestations in this study included 38 cases of abdominal mass 65% (24/38), abdominal pain 52% (19/38), abdominal distension 18% (7/38), and precocious puberty 3% (1/38), which also reflects the above-mentioned the clinical features of ovarian tumors in children. With regards to diagnosis, ultrasound is the main method, and CT/MRI, reproductive hormone inspection, and ovarian tumor inspection can also be combined in order to assist the diagnosis if necessary [22]. The outcome of patients with Stage I disease is excellent in 99.7%, with children having corresponding survivals of 100% [23].

With the development of laparoscopic techniques, laparoscopic surgery has become a routine surgical approach toward gynecological benign tumors, and even early gynecological malignancies, and its advantages have been recognized. Given the clinical and pathological features of ovarian tumors in children, the present authors believe that laparoscopic techniques can also be applied in the treatment of ovarian tumors in children. Through clinical practice, they also believe that laparoscopic surgery has the following advantages in treating ovarian tumors in children than open surgery: (1) it combines the diagnosis and treatment in one step, so early diagnosis and simultaneous treatment can be carried out, thus reducing the laparotomy rate and unnecessary large incision; (2) it produces smaller incisions, which are preferred and reduces the infection rate, and is more conducive to the mental health in young children; (3) due to its wide field of vision, a small incision can enable full-range abdominal exploration in order to clear lesions, and it will not be affected by patient's size or abdominal wall thickness; (4) it causes less disturbance and pollution towards the abdominopelvic cavity and intestinal tract, and the incidence of postoperative ileus and pelvic adhesion will be low, so the bowel functions can recover more rapidly; (5) postoperative eating and ambulation can be performed earlier, the hospital stay can be shorter, and related pain can be less.

During the practice of laparoscopic surgery in treating ovarian tumors in children, the following points should be considered: the surgical indications should be strictly controlled; laparoscopic surgery is mainly applied for benign ovarian tumors. With regards to early-stage malignant ovarian tumors confirmed by comprehensive preoperative inspection, if the tumor size is small (< 10 cm), and the specimen can be completely removed , laparoscopic surgery is also feasible [24]. Therefore, under permissive conditions, relevant inspections should be performed as much as possible. With regards to giant ovarian tumors, if the likelihood of malignancy is suspected intraoperatively, timely laparotomy should be recommended; (2) children's abdominal wall tissue is weak, CO_2 pneumoperitoneum pressure should be controlled around 10 mmHg, so the impacts of pneumoperitoneum on children can be reduced, and a certain operative space can also be maintained. The present research center also applies the same pneumoperitoneum pressure for elderly patients, and the surgical results are satisfactory; (3) when performing ovarian tumorectomy, separation scissors should be used to cut the ovarian cortex, and electric surgical techniques should be avoided in order to reduce heat conduction-induced ovarian damages. If no significant active bleeding appears, ovarian wound bleeding can arrested and sutured using fine thread and needle; if significant active bleeding occurs, bipolar electric coagulation can be performed firstly to stop bleeding, followed by ovarian suture. The remaining ovarian tissue needs no pruning so as to retain normal ovarian tissue as much as possible, and minimize damaging the ovary; (4) when stripping the ovarian tumor, the integrity of the tumor should also be maintained as much as possible, and cystic fluid leakage should be avoided. If the tumor ruptures during the separation, the body position should be restored firstly, which is converted from the Trendelenburg position to the horizontal position, even in the reverse Trendelenburg position, in order to reduce flushing difficulties caused by the cystic fluid flowing into the abdominal cavity. Meanwhile, pelvic cavity should be thoroughly washed, and the flushing fluid should not be extensive, and should be suctioned simultaneously while washing in order to avoid excessive fluid flowing beyond the pelvic cavity and entering the abdominal cavity. Through the above measures, cystic fluid residual can be generally reduced, and the incidence of chemical peritonitis, as well as the spread and growth of residual tumor cells, can be reduced. Of course, of most importance is to perform the surgical operations carefully so in order to fundamentally avoid the rupture of ovarian tumors. The 35 cases enrolled in this study had no tumor rupture, and all the patients recovered well without peritonitis; the follow-up has found no relapse until now; (5) after stripping the ovarian tumor, it needs to slowly be removed, which can be placed in a suitable position; arresting ovarian bleeding should be the first thing to be performed, thus reducing intraoperative blood loss; (6) with regards to giant benign ovarian tumors (generally with the diameter >15 cm), it will be difficult to directly strip them, so one puncture needle can be used to suction partial cystic fluid, followed by stripping after having ligated the puncture site. It is not recommended to completely suction the cyst fluid, which will cause the cystic wall to collapse, thus resulting in tension loss-induced stripping difficulties; (7) due to shallow pelvic cavity and small pelvic volume in children, tumors may easily enter the abdominal cavity, so the activities can be increased; moreover, due to relatively longer inherent ovarian ligament in children, tumor activities are larger, combined with the unbalanced weight of teratoma, and it is easy for teratoma to cause torsion [14]. Children's

ovarian development is still not completed, as well as their ovaries are relatively smaller, so normal ovarian tissue preservation should be considered. With regards to patients with shorter torsion time, teratoma should be reduced as much as possible, and ovariectomy should not be randomly performed. The cases with ovarian torsion enrolled in this study were stripped from the tumors and retained the ovaries after reducing the tumors, and no postoperative pulmonary embolism occurred; (8) prognosis of malignant ovarian tumors in children is good, the survival period is long, and fertile opportunities can still be retained; malignant epithelial tumors are rare, which mainly is germinocarcinoma, but sensitive to chemotherapies. Therefore, surgical approaches toward early malignant ovarian tumors should mainly focused on preserving the fertility functions, and the children with high-risk factors should be added chemotherapies [15, 25, 26].

Given the onset characteristics of ovarian tumors in children, the present authors recommend that routine abdominopelvic ultrasound should be performed toward the children with such symptoms as abdominal pain and distension, or during their physical examination so as to increase the detection rate of ovarian tumors, reduce the incidence of ovarian function impairment, ovarian torsion, or canceration. According to research in China and abroad, as well as the present authors' clinical experience, they believe that laparoscopic surgery is safe and effective when used for ovarian tumors in children, and its advantages such as small incision, quick recovery, and rapid recovery can be more readily accepted by children and their parents. Therefore, with strict control of the indications, laparoscopic surgery has a high clinical value for the treatment of ovarian tumors in children.

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