Optimal Technique for Laparoscopic Oophorectomy for Ovarian Tissue Cryopreservation in Pediatric Girls

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Key Points

- OTC is the only pretreatment fertility preservation option for prepubertal children at high risk for premature ovarian failure and infertility
- There is no defined standard surgical technique for the procurement of ovarian cortical children for cryopreservation in children
- Laparoscopic oophorectomy for OTC is a safe, proactive option for pediatric girls facing medical treatment with a high risk of fertility loss
- We recommend that a laparoscopic unilateral oophorectomy for OTC be carried out with minimal manipulation to the ovarian capsule, preservation of the ipsilateral fallopian tube, and division of the ovarian artery as the last step of the procedure to maintain the integrity of the ovary for cryopreservation and the presence of adnexal structures for potential future transplantation

10.1 Introduction

Ovarian tissue cryopreservation (OTC) provides children who face a fertility-threatening treatment an option to cryopreserve their ovarian tissue prior to receiving potentially sterilizing medical therapy [1]. Although OTC remains an experimental method of fertility preservation, this option has an even more powerful impact given the reported pregnancies achieved by two women who had their ovarian tissue cryopreserved in childhood prior to stem cell transplant [2, 3]. The state of the science is such that for both premenarchal and postmenarchal girls, there is more hope than ever that cryopreservation of the ovarian tissue may allow for the possibility of a natural pregnancy and biologically related child in the future.

To date, there has not been one standard operation for ovarian cortical tissue harvest. Techniques described include ovarian cortical biopsy, unilateral or bilateral hemi-oophorectomy, unilateral oophorectomy, and oophorectomy with excision of the vascular pedicle [4]. It is our institution's preference to perform a laparoscopic unilateral oophorectomy to maximize the amount of cortical tissue harvested for cryopreservation purposes while minimizing the risk of operative complications for the patient. This chapter aims to describe the preoperative, intraoperative, and postoperative considerations for laparoscopic oophorectomy for OTC.

10.2 Preoperative Considerations

For the pediatric surgeon who is asked to perform the oophorectomy, it is important to remember that treatment of the potentially life-threatening medical condition is the primary goal for both the parents and the medical team. Children who are candidates for OTC often require other procedures as part of their diagnosis or treatment, including central venous access, tumor biopsy, lumbar puncture, and/or bone marrow biopsy. Whenever possible, the oophorectomy for OTC should be coordinated under the same anesthesia with these necessary procedures. Our policy is to treat the OTC operation as an urgent case, often completed within a week of consultation, as not to delay medical therapy.

It is important to check preoperative laboratory studies, such as a complete blood count, prior to proceeding with OTC. This is crucial in children with hematologic pathology or those who have received previous chemotherapy who may have significant anemia or thrombocytopenia that requires correction preoperatively.

Laparoscopy is preferred to minimize the expected recovery time for the patient but may not be possible in some patients with intra-abdominal or intrapelvic tumors. These children may require an open incision via Pfannenstiel or midline laparotomy for OTC. Another option is to perform the oophorectomy during the initial tumor resection or debulking (Fig. 10.1). Regardless of the planned approach, the patient is asked to void just prior to entering the operating room in order to avoid the use of a Foley catheter. A decompressed bladder allows for optimal intraoperative visualization and manipulation of the adnexal structures in order to safely perform the unilateral oophorectomy.

10.3 Operative Technique

The technical details matter when removing an ovary for fertility preservation, even though the procedure itself is relatively straightforward. The ovary should be handled and treated with care as a potential organ for transplant. The laparoscopic approach typically involves a 10-mm umbilical port to accommodate the endoscopic retrieval bag, which facilitates quick removal of the ovary from the patient's body once the final ovarian arterial blood supply has been divided. Two additional 5-mm ports are needed for the dissection, which most often include left lower quadrant and suprapubic locations, for removal of the right ovary. This orientation is the same as that typically used for laparoscopic appendectomy, which is familiar to pediatric surgeons. Alternative port placements can be considered according to the child's age and abdominal size. (Fig. 10.2) The procedure begins with clear visualization of the uterus and both ovaries. This requires careful lifting of the fallopian tubes to view the entire ovary for any cysts or masses (Fig. 10.3). If both ovaries are normal, then dissection of the right ovary typically ensues, due to the laparoscopic orientation as described and its location away from the sigmoid colon. In patients who will receive asymmetric pelvic radiation, it is generally advisable to remove the ovary which will receive the higher

Fig. 10.1 Large rhabdomyosarcoma arising from the bladder in a 5-year-old girl who underwent an open oophorectomy for ovarian tissue cryopreservation at the time of her open tumor debulking procedure

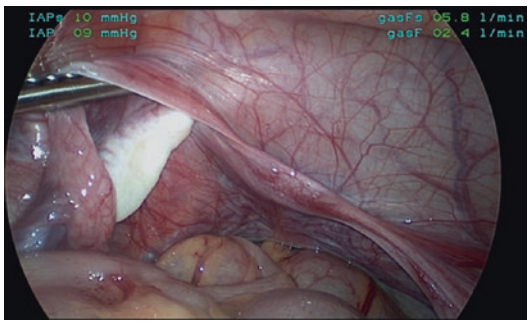

Fig. 10.3 Inspection of the uterus, fallopian tubes, and ovaries in a prepubertal girl

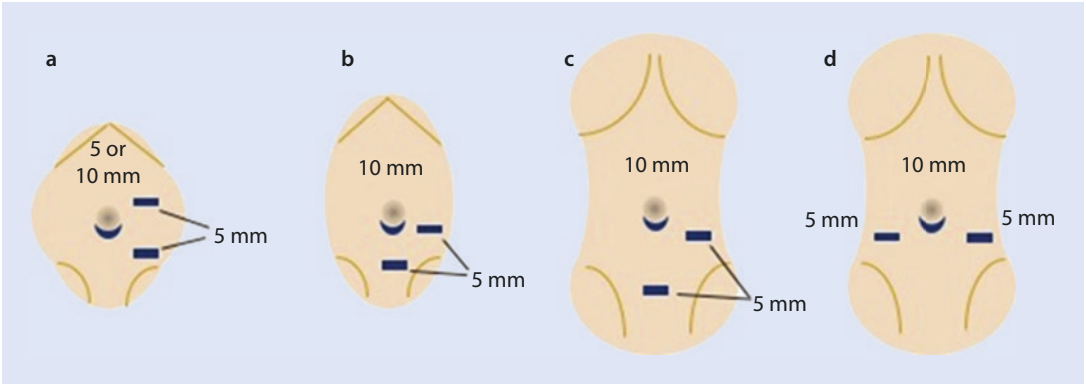

Fig. 10.2 Laparoscopic trocars for unilateral oophorectomy in **a** infant, **b** preadolescent, and **c**, **d** adolescent girls. The monitor is located at the foot of the bed for the majority of operations

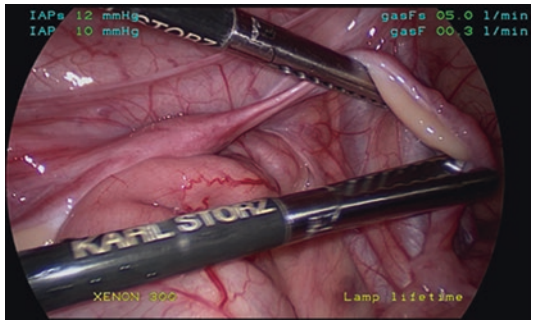

Fig. 10.4 Right ovary of a prepubertal girl with a long ovarian ligament and narrow mesovarium

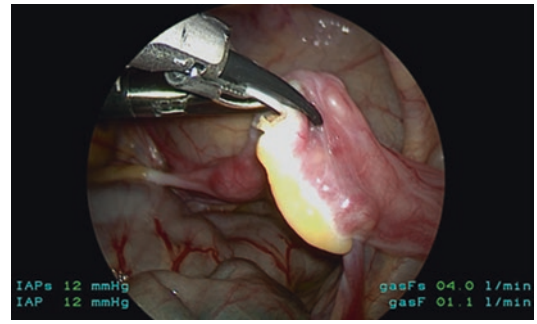

Fig. 10.5 Medial to lateral dissection of the mesovarium along the right ovary of a prepubertal girl. A small rim of tissue is used to facilitate a "no touch" dissection with minimal manipulation of the ovarian capsule

radiation dose. If the left ovary is appropriate for removal, then the suprapubic port is eliminated in favor of a right mid-abdominal 5-mm trocar. At times, both 5-mm ports are positioned in the left or right abdomen (opposite from the ovary), particularly in very young patients (Fig. 10.2).

In infants and pre-adolescent girls, the ligament of the ovary is long, the mesovarium is often narrow, and the fallopian tube is located very close to the ovary, all of which increase the possibility of burn damage if the mesovarium is divided (Fig. 10.4). The mesovarium of the broad ligament between the ovary and the fallopian tube is grasped, and the mesovarium is divided using the harmonic scalpel, at the isthmus, the location where it joins the uterus. Salpingo-oophorectomy may be required in very young girls where the mesovarium is too narrow to allow for safe tissue division using the harmonic scalpel without damaging the ovarian capsule. In peripubertal girls and teenagers, the mesovarium may be wide enough to provide a safe plane of dissection between the ovary and fallopian tube, without the need for concomitant salpingectomy. The goal is complete dissection with a no-touch technique of the ovarian capsule. The no-touch technique is achieved by creating a rim of tissue to act as a handle while dividing the mesovarium from medial to lateral (Fig. 10.5). The ovarian artery within the suspensory ligament of the ovary is divided as the final step to preserve the main arterial blood supply to the ovary during the dissection. Prior to dividing the vascular pedicle, the operating room team is alerted that the blood supply will be divided so the team is ready for specimen removal. The ovary is then quickly placed in an endoscopic retrieval bag and removed through the umbilical incision. If needed, the fascial incision is extended to minimize any crush injury to the ovary as it is being extracted. Once removed, a 4-mm biopsy punch of the ovary is obtained and submitted to the anatomic pathology lab as a routine specimen. The ovary is then placed into the cryopreservation media as quickly as possible after division of the ovarian artery.

Particularly for the youngest pediatric patients with very small ovary size, the attention to detail during the oophorectomy ensures that the maximum amount of ovarian tissue is available for preservation. Even small areas where the heat source is too close to the ovarian capsule may have catastrophic burn effects on the tissue, damaging many of the primordial follicles that lie just below the ovarian capsule. Maintaining the ovarian arterial blood supply until the very end of the dissection is crucial in all patients but particularly in younger patients with smaller vessels. In the adult literature, the Endo GIA stapler has been used to divide the ovarian blood supply and surrounding tissue, thus eliminating the need for any heat source during the dissection [5]. However, in pediatric patients, this can be problematic for several reasons: (1) need for a 12-mm trocar to accommodate the stapler and (2) small size of the pelvis in young girls which makes manipulation of the stapler difficult. Another report of laparoscopic ovarian tissue collection in the pediatric age group describes partial oophorectomy of both ovaries, using a heat source to coagulate the cut surface of the ovary [6]. We do not recommend this approach because of simultaneous damage to both ovaries and risk of hemorrhage from the raw surfaces of the ovary. Particularly in very young preadolescent patients, the ovaries are small and partial oophorectomy would risk damaging both the excised ovarian tissue and the remaining ovary left in situ.

10.4 Summary

Laparoscopic oophorectomy for OTC is a safe, proactive option for pediatric girls facing medical treatment with a high risk of fertility loss. Based on our institution's experience, we recommend that a laparoscopic unilateral oophorectomy for OTC be carried out with minimal manipulation to the ovarian capsule, preservation of the ipsilateral fallopian tube, if possible, and division of the ovarian artery as the last step of the procedure in attempt to maintain the integrity of the ovary for cryopreservation and the presence of adnexal structures for potential future transplantation.

Review Questions and Answers

Q1. Is there a defined surgical technique for the procurement of ovarian cortical tissue for OTC in children?

A1. No, there has not been one standard operation for ovarian cortical tissue harvest. Techniques described include ovarian cortical biopsy, unilateral or bilateral hemi-oophorectomy, unilateral oophorectomy, and oophorectomy with excision of the vascular pedicle.

Q2. What are important perioperative considerations before proceeding with OTC in pediatric patients?

A2. It is important to check preoperative laboratory studies, such as a complete blood count, prior to proceeding with OTC. This is crucial in children with hematologic pathology or those who have received previous chemotherapy who may have significant anemia or thrombocytopenia that requires correction preoperatively.

Q3. What are the anatomic differences between the adnexa of a prepubertal girl and a postpubertal girl?

A3. In infants and preadolescent girls, the ligament of the ovary is long, the mesovarium is often narrow, and the fallopian tube is located very close to the ovary. The average volume of a prepubertal ovary is 1 cm^3 as compared to the 5–10 cm^3 volume of a postpubertal ovary.

Q4. What are the key aspects to performing a laparoscopic unilateral oophorectomy for OTC in children?

A4. Laparoscopic unilateral oophorectomy for OTC should be carried out with minimal manipulation to the ovarian capsule, preservation of the ipsilateral fallopian tube, if possible, and division of the ovarian artery as the last step of the procedure in attempt to maintain the integrity of the ovary for cryopreservation and the presence of adnexal structures for potential future transplantation.

References

1. The Practice Committee of the American Society for Reproductive Medicine. Ovarian tissue cryopreservation: a committee opinion. Fertil Steril. 2014;101:1237–43. https://doi.org/10.1016/j.fertnstert.2014.02.052.
2. Demeestere I, Simon P, Dedeken L, Moffa F, Tsépélidis S, Brachet C, et al. Live birth after autograft of ovarian tissue cryopreserved during childhood. Hum Reprod. 2015;30:2107–9. https://doi.org/10.1093/humrep/dev128.
3. Donnelly L. Woman gives birth to baby using ovary frozen in her childhood in "world first." The Telegraph. 2016.
4. Corkum KS, Laronda MM, Rowell EE. A review of reported surgical techniques in fertility preservation for prepubertal and adolescent females facing a fertility threatening diagnosis or treatment. Am J Surg. 2017;214:695–700. https://doi.org/10.1016/j.amjsurg.2017.06.013.
5. Roux I, Grynberg M, Linehan J, Messner A, Deffieux X. Ovarian cryopreservation after laparoscopic ovariectomy using the Endo-GIA stapling device and LAPRO-clip absorbable ligating clip in a woman: a case report. J Med Case Rep. 2011;5:1–3. https://doi.org/10.1186/1752-1947-5-48.
6. Lima M, Gargano T, Fabbri R, Maffi M, Destro F. Ovarian tissue collection for cryopreservation in pediatric age: laparoscopic technical tips. J Pediatr Adolesc Gynecol. 2014;27:95–7. https://doi.org/10.1016/j.jpag.2013.11.002.