Laparoscopy-assisted transumbilical extracorporeal cyst deroofing for the management of neonatal ovarian cysts

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Background
Congenital ovarian cysts affect newborn female infants with an increasing incidence. Many of these cysts are clinically insignificant and resolve spontaneously. Complex cysts of any size and simple cysts larger than 5 cm should be operated upon. Laparoscopy is becoming the mainstay of management. We report our experience with the laparoscopy-assisted transumbilical extracorporeal approach in neonates with ovarian cysts.

Patients and methods
In this prospective cohort study, 17 pregnant ladies presented with a routine antenatal ultrasound anomaly scan showing an abdominal cyst in their female fetuses, likely ovarian in origin. A multidisciplinary counseling meeting was conducted with the expectant couple. Postnatal ultrasonography confirmed the diagnosis in 15 patients, whereas two patients showed resolution. Conservative management was pursued in patients with cyst size less than 5 cm. Patients with ovarian cysts larger than 5 cm were operated upon electively.

Results
Age at surgery ranged from 4 to 11 days, and patients' weight ranged from 2.8 to 3.7 kg. Thirteen patients were full term, whereas only two were preterm. The cyst diameter (whether operated upon or not) ranged from 2.7 to 6.2 cm. All patients with cysts smaller than 5 cm resolved spontaneously over a 6-month period. Laparoscopy-assisted transumbilical extracorporeal cyst deroofing was attempted in 11 patients (mean cyst diameter, 5.6 cm). The mean operative time was 36 min. None of the patients showed recurrence or formation of new cysts.

Conclusion
Laparoscopy-assisted transumbilical extracorporeal cyst deroofing achieves safety, reproducibility, organ preservation, and minimal invasiveness in neonates with ovarian cysts.

Keywords:
cyst deroofing, neonatal laparoscopy, ovarian cysts, transumbilical surgery

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Introduction

Congenital ovarian cysts are well-known as a problem affecting up to 30% of newborn female infants [1,2]. The incidence of congenital ovarian cysts, or rather their detection, has tremendously increased with the contemporary use of prenatal ultrasonography [3,4]. Yet, many of these cysts are clinically insignificant and tend to resolve spontaneously [5]. The main parameter differentiating physiological and pathological cysts is size, with a reported cutoff value of 2 cm [3,6].

Ultrasonography, prenatally and postnatally, is the investigation of choice. Prenatal ultrasound can accurately diagnose and differentiate simple from complex cysts [7,8]. However, when a cyst is complex, an ultrasound scan cannot distinguish benign from the very rare malignant cysts [9]. However, as malignant ovarian neoplasms are rare in the fetus and the neonate, they are not commonly considered in the differential diagnosis, but MRI may then have a role in unclear situations [3].

Simple cysts smaller than 5 cm are best followed up awaiting resolution, with withdrawal of the maternal hormones. Complex cysts of any size and simple cysts larger than 5 cm should be operated upon, in the view of most surgeons, for the fear of torsion jeopardizing the remaining ovarian tissue [5].

Laparoscopy is taking the upper hand in the management of ovarian cysts after being initially described for this in 1995 [10]. In the presence of a pediatric anesthetist and a well-trained pediatric

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surgeon familiar with neonatal laparoscopy, salpingo-oophorectomy, ovarian cystectomy, and cyst deroofing can be all safely done either laparoscopically or aparoscopically-assisted in the neonatal period [11].

We, herein, report our experience with laparoscopy-assisted transumbilical extracorporeal approach in neonates with ovarian cysts, when active intervention is indicated, and evaluate laparoscopic deroofing as an organ salvage or preserving procedure, when viable ovarian tissue is thought to be present.

Patients and methods

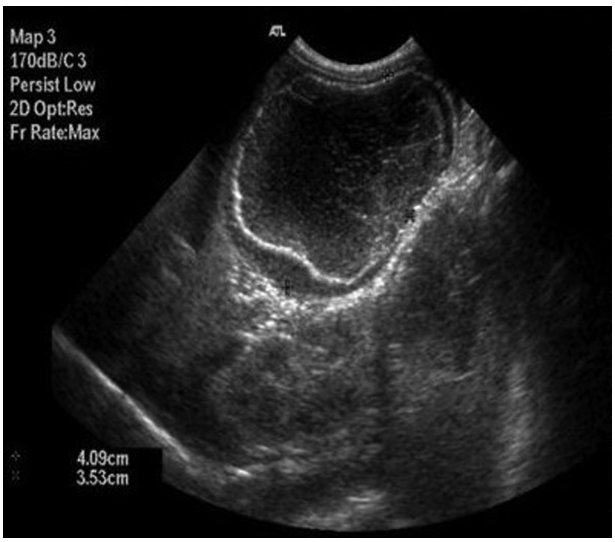
In this prospective cohort study, during the period from May 2015 till May 2018, 17 pregnant ladies presented to the obstetric clinics of two tertiary referral centers, King Abdulaziz Medical City, Al-Hasa, KSA and Cairo University Specialized Pediatric Hospital, Egypt, with a routine antenatal ultrasound anomaly scan showing an abdominal cyst that is most likely ovarian in origin in their female fetuses. The linked pediatric surgery service was notified, respectively, and a multidisciplinary antenatal counseling meeting was conducted with the pregnant women and their spouses. No preference was made regarding the mode of delivery, that is, cesarean section was performed only in the presence of an obstetric indication. Postnatal ultrasound examination was done for all patients to confirm the diagnosis and detect any other pathology (Fig. 1). Postnatal ultrasonography confirmed the diagnosis of ovarian cysts in 15 patients, whereas in two patients, no cysts were found postnatally, suggesting resolution of the cyst, leading to their exclusion from the study. None of the patients at birth had any worrying signs or symptoms mandating urgent exploration.

Conservative management was attempted in patients with cyst size less than 5 cm hoping that the cysts will decrease in size. Ultrasonography was repeated every 2–4 weeks to detect any significant changes. Patients with ovarian cysts larger than 5 cm were operated upon, on the nearest elective list, as long as there were no clinical or sonographic features suggesting torsion and necessitating an emergency operation. Patients on conservative management were discharged home after instructing the parents to report to the hospital immediately if they noticed any abdominal symptoms that might indicate torsion of the ovarian cyst, in the form of an unexplained pain, fever, vomiting, or if they are in doubt, about any general illness.

Operative technique

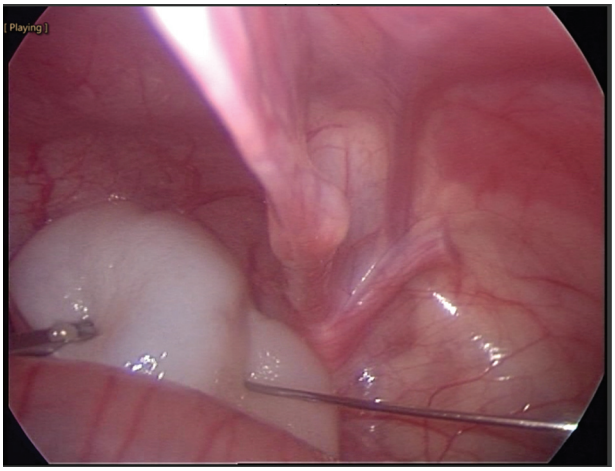
Under general anesthesia, laparoscopy was established. Three-millimeter laparoscopic instruments were used. A 5-mm port (cannula) was placed in the infra-umbilical region using the open Hasson technique. With careful monitoring of the cardiopulmonary status, pneumoperitoneum was created with a 0.5 l/min flow of CO_2 insufflation and pressure maintained at 6–8 mmHg. After the cystic lesion was visualized and evaluated laparoscopically, a 3-mm working port was put in the contralateral iliac fossa. Aspiration of the cyst's contents was done using a spinal needle percutaneously, through the abdominal wall, under laparoscopic direct vision (Fig. 2). Care was taken to avoid any spillage of the contents, and the aspirated fluid was sent for cytological examination. After

Figure 1



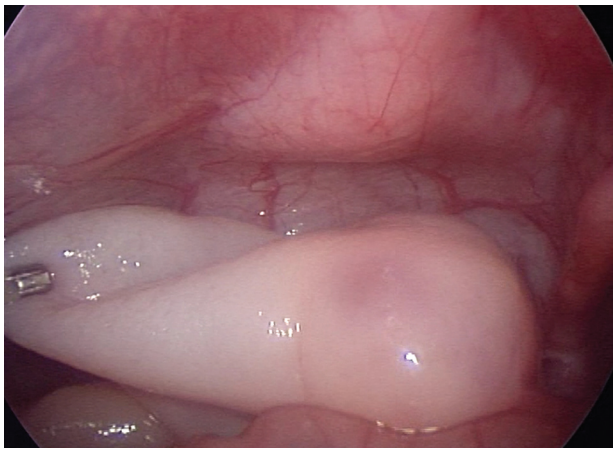
Simple cyst measuring 4.09×3.53 cm.

Figure 2



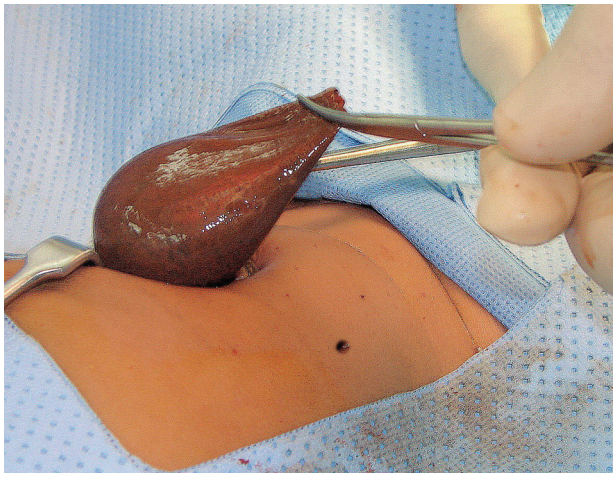
Aspiration of the cyst using a spinal needle.

Figure 3



The cyst collapsed after aspiration.

Figure 4



The cyst after exteriorization through the umbilicus.

aspiration, the size of the remaining cyst and its consistency were re-evaluated for the presence of any residual ovarian tissue (Fig. 3). The laparoscope was switched to the port in the iliac fossa, and through the umbilical port a grasper was introduced, and the cyst was pulled out after limited stretching of the muscle opening and skin incision (Fig. 4), exercising carefulness not to unduly tear or damage the ovarian pedicle. The residual cyst was palpated for any apparent ovarian tissue, and either a cystectomy or deroofing was done, away from the vascular pedicle. Hemostasis was achieved and the remaining tissue was returned to the abdomen, followed by standard closure.

The variables studied were the age at operation in days, the operative time, type of the operation done, the presence of ovarian torsion, the histopathological examination of the removed specimen, detection of ipsilateral ovarian tissue, both intraoperatively and on postoperative imaging, and the presence of complications. Follow-up of all operated upon patients continued for 6 months in the form of a clinic visit after 1 week and ultrasound scans after 1 and 6 months.

Results

The age of the patients at the time of surgery ranged from 4 to 11 days. The birth weight ranged from 2.7 to 3.5 kg (mean, 2.8 kg). Thirteen patients were full term, whereas only two were preterm. None of the patients were found to have any associated congenital anomalies. There was no preference for the mode of delivery. Vaginal delivery was done unless there was an obstetric indication for cesarean section, which was the case in three pregnancies: one for preeclampsia and two for previous cesarean sections. There were no maternal hormonal medications administered during any of the pregnancies. The overall size of the cysts ranged from 2.7 to 6.2 cm in diameter (mean, 4.9 cm). The cysts operated upon had a mean±SD diameter of 5.6±0.36 cm and a median of 5.6 cm (range, 5.0–6.2 cm). The cysts managed conservatively had a mean and median diameter of 3.0 cm (range, 2.7–3.5 cm).

Table 1 summarizes the course of the cases managed operatively. Laparoscopy-assisted transumbilical extracorporeal cyst deroofing was attempted for 11 patients, eight right-sided and three left-sided cysts. The mean operative time was 36 min (range, 29–47 min). In three patients, the aspirated fluid and the wall of the cyst were dark in color, and no definitive ovarian tissue was palpable. Two of those three cysts were not attached to any definite pedicle, and one was attached with a narrow pedicle to the surrounding tissues but disconnected from the adnexa. In those three cases, the diagnosis of a delayed asymptomatic ovarian torsion was suspected, so removal of the whole cyst was carried out. No other ovarian tissue was seen on the ipsilateral side in patients with this autoamputation. Histopathological examination of the three cysts removed was suggestive of fetal or early neonatal ovarian torsion.

In the remaining eight patients, the fluid aspirated was straw colored, the wall of the cysts looked viable and the cysts were attached to a vascular pedicle at their base. The thickening at the base of the cyst walls was apparently viable ovarian tissue. Histopathological examination of the wall of the cysts removed after deroofing in these patients showed a picture of follicular ovarian cysts with no evidence of malignancy.

Feeding was initiated shortly after the patients were fully recovered from anesthesia and the patients were

Table 1 Summary of cases managed surgically

	Antenatal comorbidities	Size before operation (cm)	Side	Postnatal features and complications of the cyst	Age at operation (days)	Procedure	Histology	Torsion	Operation time (min)
Case no. 1	None	5.6	Right	None	7	Deroofing	Follicular cyst	Absent	47
Case no. 2	Rh incompatibility	6	Left	Vomiting	8	Deroofing	Follicular cyst	Absent	42
Case no. 3	None	5.4	Right	None	7	Deroofing	Follicular cyst	Absent	35
Case no. 4	Preeclampsia	5.9	Right	Hemorrhage	11	Cystectomy	Ovarian torsion	Present	38
Case no. 5	Gestational diabetes	6.2	Right	Hemorrhage	9	Cystectomy	Ovarian torsion	Present	33
Case no. 6	None	5.5	Right	Abdominal distension	4	Deroofing	Follicular Cyst	Absent	40
Case no. 7	None	5	Left	None	10	Deroofing	Follicular cyst	Absent	29
Case no. 8	Gestational diabetes	5.6	Right	Hemorrhage	6	Cystectomy	Ovarian torsion	Present	35
Case no. 9	None	6	Right	None	5	Deroofing	Follicular cyst	Absent	29
Case no. 10	None	5.3	Right	None	8	Deroofing	Follicular cyst	Absent	37
Case no. 11	None	5.5	Left	None	9	Deroofing	Follicular cyst	Absent	32

Table 2 Cases managed conservatively

	Antenatal comorbidities	Size at confirmation of diagnosis postnatally (cm)	Side	Postnatal features and complications of the cyst	Complexity
Case no. 1	None	2.7	Right	None	Simple cyst
Case no. 2	None	3.5	Left	Vomiting	Simple cyst
Case no. 3	None	2.9	Right	Vomiting	Simple cyst
Case no. 4	None	3	Right	Inconsolable crying	Simple cyst

discharged on the following day. The umbilical port site scars were completely healed with no wound complications when reviewed 2 weeks postoperatively. Patients who underwent deroofing of the cyst wall showed no formation of new cysts. Ovarian integrity, by ultrasound, was preserved bilaterally at 6 months after surgery in all eight patients.

On the other hand, six patients were managed conservatively: two with no detected postnatal cysts and four with cysts smaller than 5 cm (Fig. 1). Table 2 displays the postnatally detected cysts managed conservatively. Three patients of this group presented to the emergency department: one complaining of excessive inconsolable crying and two with nonbile-stained vomiting. An urgent ultrasonography was done which did not show any change to the previous findings of these particular patients. All patients with cysts smaller than 5 cm resolved spontaneously over a 6-month period.

Discussion

Prenatal ultrasonography plays a crucial role in the diagnosis of abdominal and ovarian cysts. It allows us to progressively understand the natural history [7]. Most neonatal ovarian cysts are follicular in origin. Therefore, they tend to resolve spontaneously after delivery [12]. Cysts less than 2 cm are reportedly not of any clinical significance [3,6]. We found that neonatal ovarian cysts can easily be detected by antenatal ultrasound. Sonographically, an antenatal ovarian cyst manifests as a hypoechoic cyst superior and lateral to the bladder. It may be thin walled or double walled (as if showing a cyst inside a cyst, termed daughter cyst), which is pathognomonic for its ovarian origin [3]. In our series, neonatal ovarian cysts were more common on the right side (73%), which is similar to Akin *et al.* [6], who found the cysts to be right sided in 75%. Interestingly, we noted that right-sided cysts were more commonly subjected to complications, possibly owing to limitation of movement of the left ovary by the sigmoid colon. Turgal *et al.* [7] reported that in seven (35%) of 20 ovarian cysts, resolution of the cyst occurred prenatally. Whilst, in our series, two cases out of 17 ovarian cysts showed prenatal resolution.

Manjiri *et al.* [13] noted that out of 25 fetuses with ovarian cysts, 14 (56%) underwent spontaneous postnatal regression by 6–8 months. This is relatively higher but comparable to our series (6/15 cases – 40%) and justifies our conservative approach to management, unless the cyst is complex or large (>5 cm) predisposing to ovarian torsion and loss of

ovarian tissue [3]. All cysts smaller than 5 cm in diameter resolved without any active management.

Although our operative time was longer in our first two cases (mean, 45 min), the overall mean time (36 min) is comparable with the operative time reported in the literature for different approaches to manage neonatal ovarian cysts. Al-Zaiem [14] reported an operative time ranging from 25 to 60 min for the laparoscopy-assisted approach. Similarly, Lin *et al.* [15] in their report published in 2007 about the transumbilical management reported an operative time ranging from 21 to 43 min. In our cohort, the cysts operated upon had a mean diameter of 5.6 cm, which is not dissimilar to other authors, reporting a mean diameter of 5.3 cm [6].

We neither had significant complications nor did we have any recurrence during the 6-month follow-up period. This is in line with the reports highlighting safety and efficacy of laparoscopy-assisted deroofing, as well as other approaches [5,6,11,14,15].

The described technique is not an absolutely novel technique; however, we herein used miniaturized 3-mm scope and instruments in 11 neonates, consistently through only two ports, thus opted to report our experience with this established, albeit not yet very popular technique, to confirm its safety and efficacy in the neonatal period, adding to the published evidence and literature.

Laparoscopic approaches were first introduced for the management of ovarian cysts by van der Zee *et al.* [10]. Laparoscopy is superior to laparotomy in terms of thorough exploration of the abdominal cavity, cosmesis, postoperative pain, and duration of hospital stay. On the contrary, hemodynamic sequelae of insufflation may be troublesome in neonates. Furthermore, laparoscopy has a steeper learning curve and requires a working space that is already partially occupied by the cyst. Some authors suggested a circumumbilical incision, as described by Bianchi for pyloromyotomy, to approach the ovarian cysts. This is not our preference, as we believe that blind traction on the cyst toward the umbilicus may cause rupture or iatrogenic avulsion.

In 2008, Schenkman *et al.* [11] described the laparoscopy-assisted approach of cyst aspiration and transumbilical cystectomy (cyst excision with ovarian preservation) or salpingo-oophorectomy and noted the advantages of less operative time and quicker recovery compared to the fully laparoscopic or laparotomy approaches. Camoglio *et al.* [8] managed to perform the laparoscopy-assisted approach as a day-case surgery for patients older than 6 months.

Looking into techniques with a similar concept to the studied one, we found that other groups have advocated different variants as single-incision pediatric endosurgery or single-incision laparoscopic surgery, with reasonable success and versatility [16–18]. Laparoendoscopic single site surgery using an angiocatheter needle with possible Knife-in-bag morcellation has been reported in older patients with huge ovarian cysts (diameter, 15–30 cm), with no need for additional laparoscopic ports and reasonable outcome [19].

There is no consensus on the best operation for managing ovarian cysts [6]. Salpingo-oophorectomy, cystectomy, and deroofing can all be done laparoscopically. We believe that deroofing is the best option as it is less time consuming, carry larger chance of salvaging the ovarian tissue stretched on the cyst wall, and still provides tissue for histopathology. Comparatively, as ovarian tissue is sometimes unidentifiable during surgery, it may be removed or injured inadvertently during a cystectomy.

Conclusion

We found that the laparoscopy-assisted transumbilical extracorporeal cyst deroofing approach, using two laparoscopic ports, is safe and feasible in neonates with ovarian cysts. Delivery of the cyst into the umbilicus and incision along the interface with residual ovarian tissue was accurate and safe, being under vision throughout the procedure.

Authors' contributions

All authors contributed toward the surgical procedures and care as well as the acquisition, analysis, and interpretation of the data. Atef S. A. Elbarawy conceptualized the study design and basis and has overseen the study. Ahmed A. Youssef initiated and drafted the manuscript. Mahmoud M. Marei, Mohamed H. Abouelfadl, and Wesam M. Mahmoud contributed to the literature review. Mahmoud M. Marei carried out the overall editing of the manuscript and critique (discussion). Ahmed A. Youssef and Mahmoud M. Marei shared the first authorship contribution, including response to the peer reviewers.

Ethics declaration and consent statement

This study followed the principles of the World Medical Association (WMA) Declaration of Helsinki. Consent for any clinically indicated

surgical procedure or medical intervention followed the standard informed and written documentation, which entails parental consent for sharing the patient's non-identifiable clinical data for educational and research purposes.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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