Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Experience of para-umbilical small-incision open minimally-invasive surgery for neonatal ovarian cysts: a practical option for resource-limited regions without laparoscopic facilities

Yuan Xue
The Qingdao Women and Children's Hospital
Kaiyue Cui
The Qingdao Women and Children's Hospital
Hua Song
xiudi2000@163.com

The Qingdao Women and Children's Hospital

Research Article

Keywords: Neonatal ovarian cyst, Para-umbilical small incision, Ovarian torsion, Resource-limited settings, Open minimally-invasive surgery

Posted Date: November 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11478039/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Experience of para-umbilical small-incision open minimally-invasive surgery for neonatal ovarian cysts: a practical option for resource-limited regions without laparoscopic facilities

Yuan Xue [1], Kaiyue Cui[1], Hua Song[1*]

***Correspondence:**

Hua Song

xiudi2000@*163.com*

1 Department of Pediatric Surgery, The Qingdao Women and Children's Hospital, Shibei District, No.6,Tongfu Road, Qingdao, China

Abstract

Background: Neonatal ovarian cysts represent one of the most common intra-abdominal cystic lesions in female fetuses. Laparoscopic surgery offers minimally-invasive benefits but is often unavailable in low-income, remote and under-resourced settings due to limitations in equipment, consumables and trained personnel. This study aimed to summarize our clinical experience of para-umbilical circular small-incision open surgery for neonatal ovarian cysts and evaluate its applicability for medical institutions lacking laparoscopic hardware.

Methods:A retrospective observational study was performed on 29 neonates undergoing surgical management for ovarian cysts between November 2023 and September 2026. Patients were divided into a para-umbilical small-incision group (n=22) and a conventional open incision group (n=7). Baseline demographics, intraoperative parameters, postoperative recovery outcomes, surgical complications and parental satisfaction were compared between groups. Normality was assessed using the Shapiro-Wilk test. The Mann-Whitney U test was used for non-normally-distributed continuous variables, while Fisher's exact test was applied for categorical data. A significance level of α=0.05 was defined. Key surgical steps were summarized and illustrated with operative diagrams.

Results: Neonatal postnatal age and cyst diameter were significantly smaller in the para-umbilical group compared with the conventional group (P<0.05). The para-umbilical small-incision group demonstrated significantly shorter operation time (31.1 ± 5.3 min versus 40.9 ± 3.2 min, P<0.001), less intraoperative blood loss (1.7 ± 0.7 mL versus 2.7 ± 0.8 mL, P=0.009), earlier time to postoperative oral feeding (1.3 ± 0.5 d versus 2.9 ± 0.7 d, P<0.001), and shorter length of hospital stay (4.2 ± 0.8 d versus 6.4 ± 0.8 d, P<0.001). Postoperative vomiting occurred exclusively in the conventional group (0/22 versus 2/7, P=0.052), showing a borderline statistical trend. No significant inter-group differences were detected regarding ovarian necrosis, abnormal incision healing and full-score parental satisfaction (P>0.05). Long-term follow-up outcomes were favourable in all enrolled neonates.

Conclusions: This single-centre retrospective study suggests potential peri-operative benefits of the para-umbilical small-incision approach for neonatal ovarian cysts. The procedure can be completed under direct vision without laparoscopic instruments or pneumoperitoneum and has relatively low requirements for anaesthesia and hardware resources. However, baseline imbalances between groups preclude causal inference of technical superiority. It may serve as a practical alternative for primary-care hospitals and resource-limited regions when laparoscopic equipment is unavailable. Given the retrospective non-randomized design and small sample size, further large-scale multi-centre studies are required to confirm its clinical benefits.

Keywords: Neonatal ovarian cyst; Para-umbilical small incision; Ovarian torsion; Resource-limited settings; Open minimally-invasive surgery

Background

Neonatal ovarian cyst is among the most frequent intra-abdominal cystic lesions in female fetuses, with a reported incidence of approximately 1 per 2500 live births. Most lesions are functional benign cysts driven by maternal hormonal exposure and fetal gonadotropin stimulation, and a large proportion resolve spontaneously after birth. Nevertheless, spontaneous regression rates decline with increasing cyst size. Complex cysts with septa, intracystic fluid-fluid levels, calcification or mixed internal echoes have substantially lower rates of spontaneous resolution, and surgical intervention is frequently indicated for persistent, enlarging or torsion-complicated cysts.

Available therapeutic options include expectant observation, ultrasound-guided aspiration, laparoscopic surgery and conventional open laparotomy. Current clinical consensus recommends maximal preservation of viable ovarian parenchyma and avoidance of unnecessary oophorectomy in neonates with ovarian cysts. Laparoscopy provides well-documented minimally-invasive advantages, yet it depends on specialized equipment, CO_2 pneumoperitoneum, dedicated consumables and surgeons with advanced laparoscopic training. In low- and middle-income countries and remote regions, these prerequisites are often unavailable; accordingly, open surgery remains the dominant practical surgical option in such contexts.

Several modified transumbilical minimally-invasive techniques, such as laparoscopic-assisted transumbilical extracorporeal cystectomy (LATEC) and periumbilical hybrid laparoscopy-assisted procedures, have been reported for neonatal ovarian cysts, achieving extracorporeal cyst management through a single umbilical-region incision. However, these approaches still require laparoscopic facilities and relevant technical expertise and therefore cannot be widely implemented in institutions without laparoscopy.

Traditional lower abdominal transverse open laparotomy is associated with longer incisions, greater abdominal wall trauma, delayed gastrointestinal recovery, prolonged hospitalisation and visible abdominal scars. The para-umbilical circular small-incision technique described in the present study is performed entirely by open direct vision with standard general surgical

instruments. Taking advantage of the thin abdominal wall and small peritoneal cavity of neonates, cyst decompression and extracorporeal resection can be completed without laparoscopic support. Clinical reports focusing specifically on this open para-umbilical approach remain scarce in English-language literature. This retrospective study summarises our single-centre clinical experience of para-umbilical small-incision surgery for 29 neonates with ovarian cysts and discusses its feasibility for resource-limited medical settings.

Data and Methods

Study design and participants

This is a single-centre retrospective observational study. Medical records of consecutive female neonates who underwent surgery for ovarian cysts between November 2023 and September 2026 were retrieved. Inclusion criteria: neonates with prenatally or postnatally ultrasound-diagnosed ovarian cysts receiving operative treatment. Surgical indications included persistent or progressively enlarging cysts, large simple cysts, complex cyst morphology or sonographic suspicion of ovarian torsion. Pre-operative abdominal ultrasound was performed for all patients to evaluate cyst dimensions, internal features and contralateral adnexal status; cystic lesions originating from the urinary bladder or gastrointestinal tract were excluded. Exclusion criteria: severe combined cardio-cerebro-pulmonary malformations and significant coagulation disorders.

Participants were stratified according to surgical approach: para-umbilical small-incision group (n=22) and conventional open incision group (n=7).

Surgical techniques

Para-umbilical circular small-incision procedure

Under general anaesthesia, standard skin preparation and draping were performed. A curved para-umbilical incision measuring 2.0-3.0 cm was created at the superolateral or inferolateral margin of the umbilicus. Subcutaneous tissue and anterior rectus sheath were incised; the rectus abdominis muscle was split along muscle fibres and the peritoneum was opened to access the peritoneal cavity. Pelvic exploration was conducted gently by digital palpation or atraumatic forceps to identify the ovarian cyst. Cyst fluid was aspirated using a puncture needle for decompression, allowing volume reduction. The decompressed cyst-ovary complex was then carefully exteriorised through the abdominal incision.

Cystectomy was performed under direct vision. Normal viable ovarian tissue was preserved whenever feasible; the residual ovarian capsule was repaired using absorbable sutures or electrocoagulation for haemostasis. The contralateral adnexa and uterus were routinely inspected intra-operatively. When ovarian torsion with irreversible necrosis (black discolouration without recovery of perfusion) was confirmed, the affected necrotic adnexal complex (ovary plus fallopian tube) was ligated and excised. After exclusion of active intra-abdominal haemorrhage and correct instrument and gauze counts, layered abdominal

wall closure was performed. Umbilical plasty sutures were applied to conceal the skin incision within natural umbilical folds.

Key operative steps:

1. Creation of a 2.5-3.0 cm curved para-umbilical incision; layered access into the peritoneal cavity.
2. Intra-abdominal exploration to characterise the ovarian cyst and assess for torsion; systematic inspection of contralateral adnexa and uterus.
3. Sufficient cyst decompression by aspiration prior to gentle exteriorisation of the cyst-ovary unit. This represents the core step of this technique, enabled by the thin abdominal wall of neonates, without laparoscopic assistance.
4. Cyst-wall stripping with maximal preservation of functional ovarian parenchyma for perfused non-necrotic ovaries; ovarian capsule reconstruction.
5. Complete resection of the necrotic ovary and ipsilateral fallopian tube for frankly necrotic torsioned adnexa.
6. Re-evaluation of bilateral adnexal structures; return of pelvic organs into the peritoneal cavity; layered fascial closure and cosmetic umbilical skin plasty.

Conventional open surgery

A traditional lower-abdominal transverse or pararectus incision (3-4 cm) was adopted. Intra-abdominal exploration, cystectomy or adnexectomy were performed following identical surgical principles as described above, followed by layered abdominal closure.

Periumbilical circular small incision surgery (Schematic diagrams: Figure 1 to Figure 6)

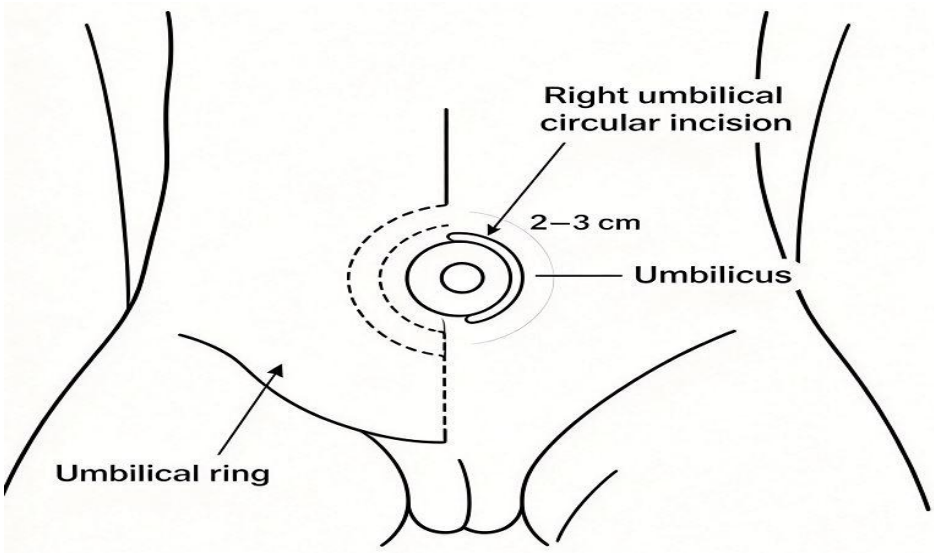


Figure 1 Schematic diagram showing para-umbilical curved skin incision, approximately 2-3 cm in length, positioned adjacent to the umbilical ring.

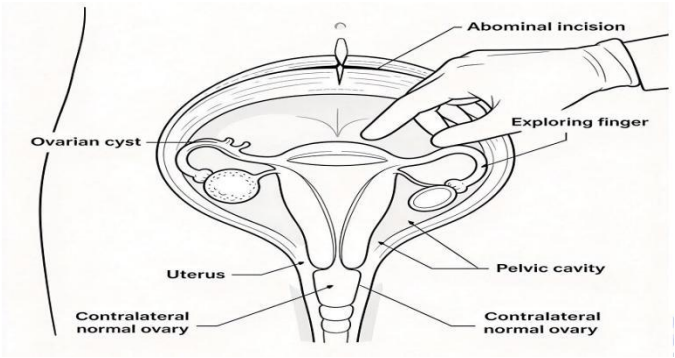


Figure 2 Intra-operative pelvic exploration by digital palpation after abdominal entry.

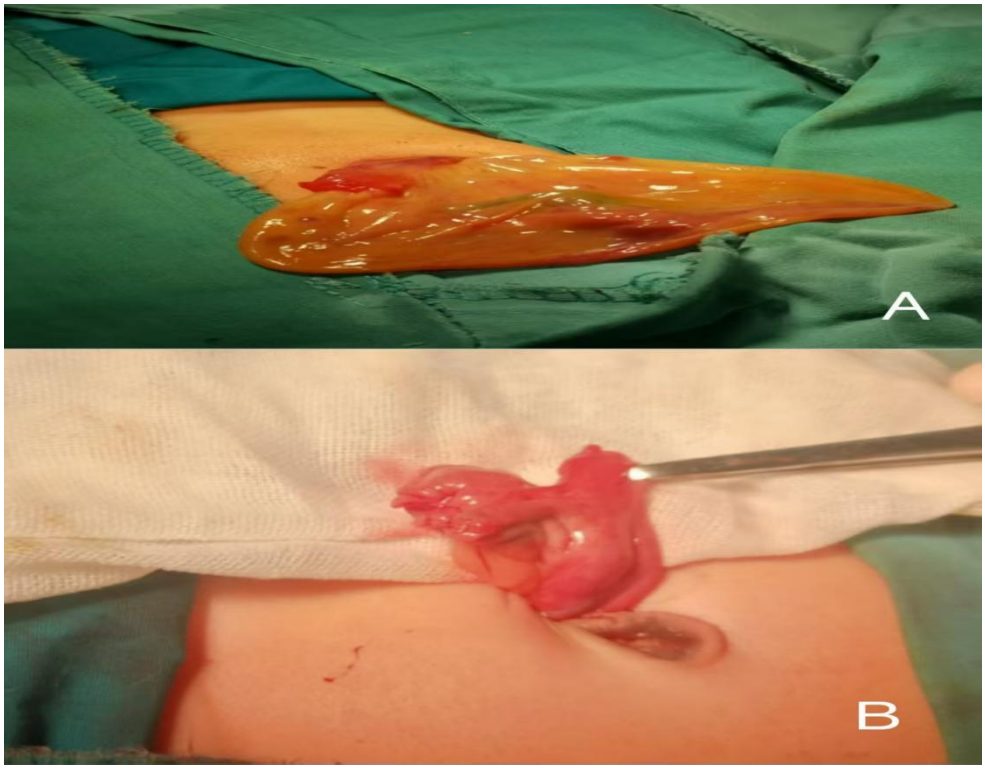


Figure 3 Cyst decompression and extracorporeal manipulation. (A) Decompressed simple ovarian cyst; (B) repaired ovary after cystectomy.

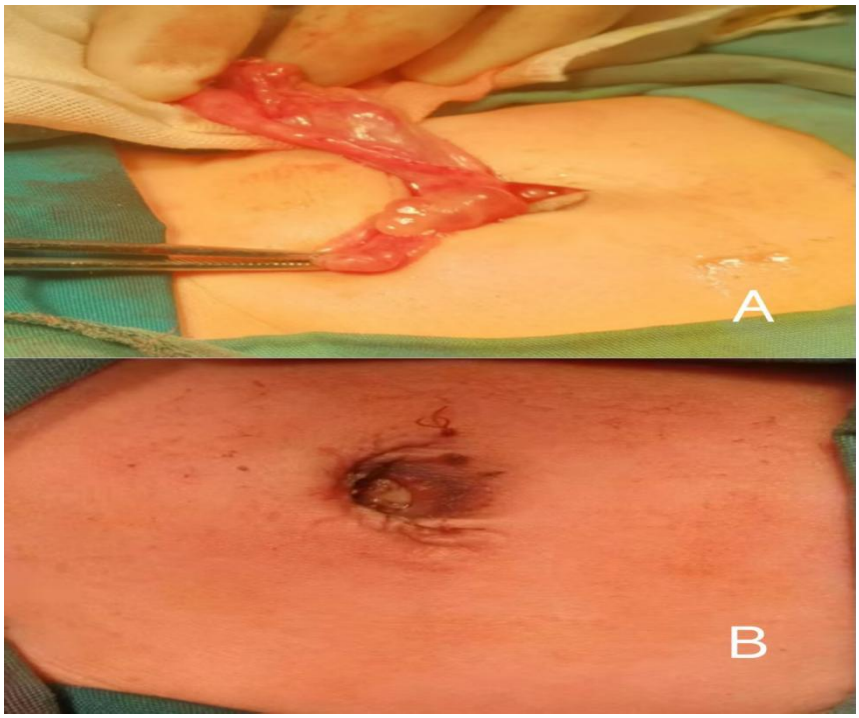


Figure 4 Inspection of contralateral adnexa and umbilical-plasty skin closure. (A) Intra-operative inspection of pelvic organs; (B) appearance of umbilical incision after plasty suture.

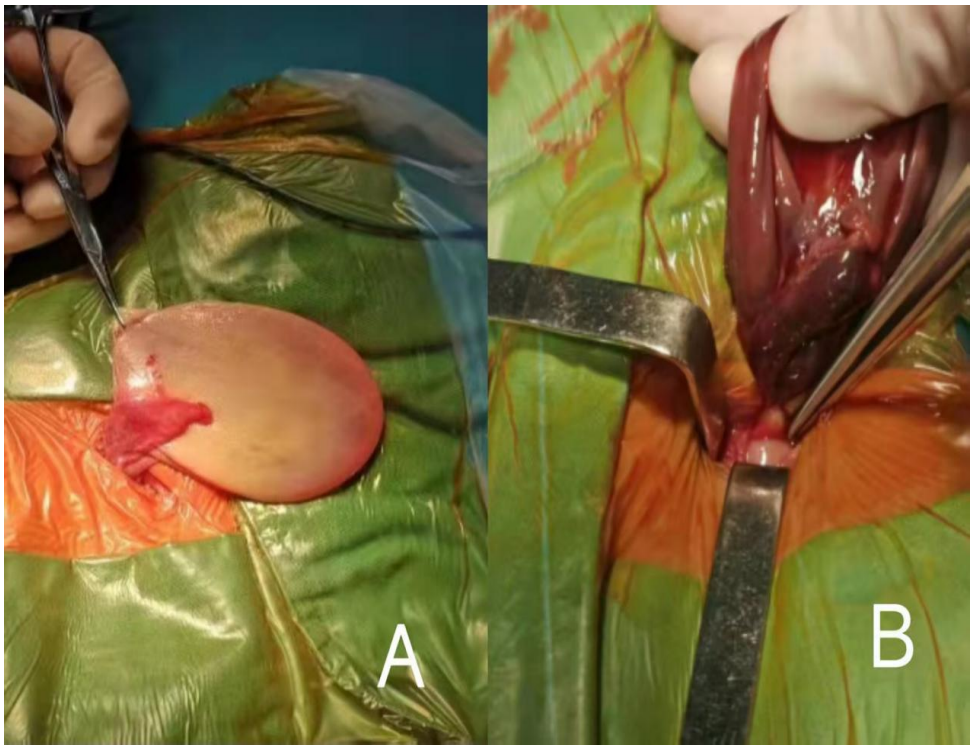


Figure 5 Intra-operative macroscopic specimens. (A) Simple thin-walled ovarian cyst with clear intracystic fluid; (B) torsioned necrotic ovary with dark haemorrhagic discolouration.



Figure 6 Post-operative umbilical cosmetic appearance; incision is fully concealed within umbilical skin folds.

Outcome measures

Collected variables included neonatal postnatal age (days), maximum cyst diameter (cm), total operation time (min), estimated intraoperative blood loss (mL), time to first postoperative oral feeding (days), length of postoperative hospital stay (days). Categorical endpoints contained intra-operative ovarian necrosis status, postoperative complications, abnormal incision healing, parental satisfaction score and long-term follow-up outcomes.

Statistical analysis

Statistical analyses were performed using SPSS software. Continuous variables were assessed for normality via the Shapiro-Wilk test. Normally-distributed data were expressed as mean ± standard deviation; non-normal data were summarised using median with inter-quartile range. Between-group comparisons for continuous variables were conducted using the Mann-Whitney *U* test. Categorical variables were presented as counts and percentages, and compared with Fisher's exact test. Statistical significance was defined as $P < 0.05$.

> Given the small overall sample size and markedly imbalanced group sizes, statistical results should be interpreted with caution. This study is hypothesis-generating rather than hypothesis-confirming.

Results

Baseline clinical characteristics

In total, 29 female neonates were enrolled in this study: 22 in the para-umbilical small-incision group and seven in the conventional open group. Postnatal age ranged from 3 d to 35 d (mean 13.9 ± 11.1 d). Cyst diameter varied between 4 cm and 8 cm (mean 5.9 ± 1.1 cm). Overall operation time was 33.5 ± 6.4 min, intraoperative blood loss 2.0 ± 0.8 mL, time to postoperative oral feeding 1.7 ± 0.9 d, and hospital stay 4.8 ± 1.2 d.

Intra-operative ovarian necrosis was identified in six patients (20.69%). Postoperative vomiting occurred in two cases (6.90%). Abnormal wound-healing events were recorded in two patients (6.90%). Twenty-eight of 29 guardians awarded full-score satisfaction, corresponding to an overall satisfaction rate of 96.55%. Long-term follow-up results were favourable for all participants without documented adverse sequelae.

Comparison of continuous variables between groups

Baseline postnatal age and cyst diameter differed significantly between groups: neonates in the para-umbilical group were younger and presented with smaller cysts (P=0.011 and P=0.002, respectively). Intraoperative and postoperative recovery outcomes were suggestive of better performance in the para-umbilical small-incision group, with shorter operative duration, reduced blood loss, earlier oral feeding and shorter hospitalisation; all inter-group differences reached statistical significance (Table 1).

Table 1 Comparison of continuous clinical outcomes between para-umbilical and conventional open-surgery groups (mean ± SD)

Variable	Para-umbilical group (n=22)	Conventional group (n=7)	P-value (Mann-Whitney U)
Postnatal age (d)	10.9 ± 10.2	23.6 ± 8.1	0.011
Cyst diameter (cm)	5.5 ± 0.8	7.1 ± 1.1	0.002
Operation time (min)	31.1 ± 5.3	40.9 ± 3.2	< 0.001
Intraoperative blood loss (mL)	1.7 ± 0.7	2.7 ± 0.8	0.009
Time to oral feeding (d)	1.3 ± 0.5	2.9 ± 0.7	< 0.001
Length of hospital stay (d)	4.2 ± 0.8	6.4 ± 0.8	< 0.001

Comparison of categorical variables between groups

No significant differences were observed for intra-operative ovarian necrosis, abnormal incision healing or full-score parental satisfaction (P>0.05). Postoperative vomiting was only

observed in the conventional-surgery group, yielding a borderline *P*-value of 0.052 (Table 2). All patients achieved favourable long-term follow-up outcomes.

Table 2 Comparison of categorical outcomes between groups [n (%)]

Variable	Para-umbilical group (*n*=22)	Conventional group (*n*=7)	*P*-value (Fisher's exact)
Ovarian necrosis	5 (22.73)	1 (14.29)	1.000
Postoperative vomiting	0 (0.00)	2 (28.57)	0.052
Abnormal incision healing	2 (9.09)	0 (0.00)	1.000
Full-score parental satisfaction	22 (100.00)	6 (85.71)	0.241

Discussion

Management strategies for neonatal ovarian cysts include surveillance, ultrasound-guided aspiration, laparoscopic surgery and open laparotomy. Ultrasound-guided cyst aspiration cannot address ovarian torsion and carries risks of visceral injury and cyst recurrence; contralateral adnexal assessment cannot be performed under non-visualised aspiration, limiting its safety in resource-poor clinical environments. While laparoscopy delivers recognised minimally-invasive benefits, its widespread application is hindered by equipment-related barriers in low-resource regions.

In this retrospective cohort, para-umbilical small-incision open surgery was associated with shorter operative duration, less intraoperative haemorrhage, earlier resumption of enteral feeding and shorter hospital stay compared with conventional open laparotomy. However, baseline imbalances existed: larger cysts and older neonates were preferentially allocated to conventional open surgery in clinical practice. This selection bias may exaggerate the apparent treatment effect attributable solely to surgical technique.

Postoperative vomiting was restricted to the conventional-incision group with borderline statistical significance, possibly reflecting greater abdominal wall trauma and more extensive intra-peritoneal manipulation during longer open procedures. Nevertheless, interpretation should be cautious given the small sample size of the conventional group (*n*=7). Rates of ovarian necrosis, wound-healing complications and parental satisfaction were comparable, confirming that para-umbilical small-incision surgery does not increase peri-operative adverse events and demonstrates high acceptability among guardians. Long-term follow-up demonstrated satisfactory outcomes for both surgical approaches.

Optimal surgical access for neonatal ovarian cysts must balance therapeutic efficacy, operative trauma and cosmetic results. Hospital stay was markedly reduced in the para-umbilical cohort. By utilising the thin, well-vascularised periumbilical abdominal wall, this open approach minimises surgical trauma and optimises cosmetic results with scars concealed within umbilical skin folds.

This open technique shares conceptual goals with transumbilical laparoscopic-assisted approaches such as LATEC and periumbilical hybrid surgery, yet eliminates requirements for laparoscopic hardware, pneumoperitoneum and specialised laparoscopic training. Only standard paediatric open-surgical instruments are required, which greatly improves accessibility for grassroots hospitals. For cases of definitive ovarian torsion-necrosis, complete resection of the devitalised adnexa was performed in our series, consistent with published recommendations; every effort was made to preserve viable ovarian cortex whenever possible to safeguard future ovarian function.

Compared with traditional lower-abdominal transverse laparotomy, the major merits of para-umbilical small-incision surgery include: (1) reduced abdominal trauma, less gastrointestinal disturbance, earlier enteral feeding and shortened hospitalisation, lowering overall medical expenditure for economically constrained settings; (2) excellent cosmetic outcomes via hidden umbilical scars; (3) avoidance of CO_2 pneumoperitoneum and associated anaesthetic risks; (4) direct visual inspection of bilateral adnexa allowing reliable identification of ovarian torsion.

Several practical caveats should be emphasised for implementation in resource-limited hospitals. Pre-operative ultrasound evaluation of cyst size and internal composition is mandatory. This incision is not recommended for extremely large cysts, predominantly solid masses or suspected teratomas due to inadequate surgical exposure. Gentle atraumatic handling is critical; full cyst decompression must be completed before exteriorisation to prevent pedicle avulsion and haemorrhage. Bilateral ovaries and the uterus must always be inspected because bilateral neonatal ovarian cysts can occur. Overt necrotic adnexa should be excised decisively to prevent secondary infectious or haemorrhagic complications. Meticulous post-operative umbilical wound care and parental education are essential to minimise wound contamination by neonatal urine and faeces.

Worldwide, uptake of paediatric minimally-invasive surgery is hampered by equipment, financial, infrastructure and workforce shortages in many low- and middle-income and remote territories, so open surgery remains standard clinical practice. Requiring minimal resources and basic paediatric surgical competence, para-umbilical small-incision open surgery avoids the risks associated with patient inter-hospital transfer, which may result in lost opportunities for ovarian salvage. Therefore it bears tangible practical value for under-resourced regions.

Study limitations This investigation is a single-centre retrospective study. First, the overall sample size is small and group allocation is markedly unbalanced, especially only seven patients in the conventional surgery group, which limits statistical power. The borderline significant *P*-value of 0.052 for postoperative vomiting should be interpreted with great caution. Second, baseline imbalances in post-natal age and cyst diameter existed between groups; multivariate adjustment could not be performed due to limited sample size, so we cannot exclude confounding effects. Third, long-term follow-up assessment was purely descriptive (“favourable outcome”), lacking objective parameters for ovarian function such as serial pelvic ultrasound or endocrine markers. Fourth, there was no head-to-head comparison

against laparoscopic surgery. Multi-centre prospective studies with larger cohorts and structured long-term ovarian-function follow-up are warranted to further validate this technique.

Conclusions

Para-umbilical circular small-incision open surgery for neonatal ovarian cysts can be performed under direct vision without laparoscopic instruments or pneumoperitoneum. This open minimally-invasive procedure is safe and feasible. It confers benefits of limited surgical trauma, early postoperative enteral feeding, shorter hospital stay, low complication rates and favourable cosmetic results, while requiring modest anaesthetic and hardware resources. It represents a practical surgical alternative for primary-care hospitals and remote resource-limited areas where laparoscopic equipment is unavailable. Rigorous pre-operative patient selection is mandatory; caution is advised for giant cysts or predominantly solid pelvic masses when choosing this surgical access.

Declarations

Abbreviations

Not applicable.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of *The Qingdao Women and Children's Hospital*(approval No.QFELL-KY-2023-10).

The study adhered to the Declaration of Helsinki.

Consent for publication

This is a retrospective study article, and all guardians of the patients signed the informed consent forms before treatment and surgery. The patient's identity information was not disclosed and will not cause any harm to the patient.

Availability of data and materials

Yes.

Competing interests

The authors declare no competing interests.

Funding

Not applicable.

Acknowledgements

We would like to thank the Qingdao Women and Children's Hospital and all the researchers who contributed to this paper. In addition, we appreciate the cooperation of parents Qingdao Women and Children's Hospital for this study.

Authors' contributions

Yuan Xue contributed to data curation, formal analysis, investigation, methodology, and writing of original draft,resources, investigation, methodology, reviewing and editing. Kaiyue Cui contributed to formal analysis, methodology, reviewing, editing and language. Hua Song contributed to data curation, investigation and project administration.All the authors approved the final version of the manuscript. The first named author had ensured that all authors have read and approved the contents of the manuscript.

References

1. Melinte-Popescu AS, Popa RF, Harabor V. Managing fetal ovarian cysts: clinical experience with a rare disorder. Medicina (Kaunas). 2023;59(4):715. doi:10.3390/medicina59040715
2. Tyraskis A, Davidson J, Billington J, et al. Ultrasonographic features associated with previous torsion and the impact of surgery in managing neonatal ovarian cysts: a 20-year single-centre retrospective study. Pediatr Surg Int. 2023;39(1):185. doi:10.1007/s00383-023-05458-2
3. Szymon O, Fryczek M, Kotlarz A, Taczanowska-Niemczuk A. Management of neonatal ovarian cysts: a 10-year single-center experience. Pediatr Surg Int. 2025;41(1):135. doi:10.1007/s00383-024-05683-8
4. Manjiri S, Padmalatha SK, Shetty J. Management of complex ovarian cysts in newborns: our experience. J Neonatal Surg. 2017;6(1):3. doi:10.5455/jns.2017.6.1.3
5. Rombaldi MC, Barreto CG, Rombaldi RL, et al. Barriers to diffusion and implementation of pediatric minimally invasive surgery in Brazil. BMC Med Educ. 2024;24:906. doi:10.1186/s12909-024-04562-4
6. Schenkman L, Weiner TM, Phillips JD. Evolution of the surgical management of neonatal ovarian cysts: laparoscopic-assisted transumbilical extracorporeal ovarian cystectomy (LATEC). J Laparoendosc Adv Surg Tech A. 2008;18(4):635–640. doi:10.1089/lap.2007.0248
7. Kozlov IuA, Novozhilov VA, Rasputin AA. Hybrid surgery for the treatment of ovarian cysts in newborns. Khirurgiia (Mosk). 2013;(11):40–45.
8. Zhang W, Wang D, Zhang Z. Efficacy analysis of transumbilical single-port laparoscopic surgery for ovarian cysts in young infants. Chin J Pediatr Surg. 2017;16(3):242–245.

9. Brandt ML, Helmrath MA. Ovarian cysts in neonates and children. Semin Pediatr Surg. 2005;14(2):106–113. doi:10.1053/j.sempedsurg.2005.01.008
10. Comparetto C, Giudici S, Coccia ME. Fetal and neonatal ovarian cysts: what's their real meaning? J Prenat Med. 2014;8(1–2):1–6.
11. Dobremez E, Moro A, Bondonny JM. Laparoscopic treatment of ovarian cyst in the newborn. J Pediatr Surg. 2005;40(2):348–351. doi:10.1016/j.jpedsurg.2004.10.021
12. Neonatal Surgery Group, Chinese Society of Pediatric Surgery, Chinese Medical Association. Expert consensus on diagnosis and treatment of neonatal intra-abdominal cystic masses. Chin J Pediatr Surg. 2021;42(8):673–678.
13. Li S. Reflections on the development of transumbilical minimally-invasive pediatric surgery. Chin J Pediatr Surg. 2020;41(5):385–388.
14. Van der Zee DC, van Seumeren ICC, Bax KMA, et al. Laparoscopic approach to surgical management of ovarian cysts in the newborn. J Pediatr Surg. 1995;30:42–43. doi:10.1016/0022-3468(95)90606-6
15. Brandt ML, Luks FI, Filston HC, et al. Surgical indications in antenatally diagnosed ovarian cysts. J Pediatr Surg. 1991;26:276–282. doi:10.1016/0022-3468(91)90502-k
16. Chen X. Complications of pediatric laparoscopic surgery. Chin J Pediatr Surg. 2004;25:364–365.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Data.xls