Media of Health Research
Vol. 4 No. 3, August 2026, pages: 451-460
e-ISSN 2987-7784
DOI: https://doi.org/10.70716/mohr.v4i3.603

Prenatal Ultrasound Diagnosis and Conservative Management of Fetal Lower Urinary Tract Obstruction with Bilateral Hydroureteronephrosis and Severe Oligohydramnios at 23 Weeks of Gestation: A Case Report

Jackson Mandala Putra[1*], Abarham Martadiansyah[2], Nuswil Bernolian[3]
[1,2,3] Department of Obstetrics and Gynecology, Faculty of Medicine, Sriwijaya University, Palembang, Indonesia.
**Corresponding Author: jacksonmp4494@gmail.com*

Article History

Manuscript submitted:
27 May 2026
Manuscript revised:
29 June 2026
Accepted for publication:
02 July 2026
Manuscript published:
09 July 2026

Keywords

Lower urinary tract obstruction;
Megacystis;
Hydroureteronephrosis;
Oligohydramnios;
Prenatal ultrasonography

Abstract

Fetal lower urinary tract obstruction (LUTO) is a rare group of congenital anomalies characterized by megacystis, bilateral hydroureteronephrosis, and, in severe forms, oligohydramnios that predisposes to pulmonary hypoplasia and renal dysplasia. This report described a 37-year-old multigravida (G3P2A0) referred at 23 weeks of gestation with intermittent abdominal pain and a suspected fetal anomaly. Serial fetal ultrasonography demonstrated bilateral hydronephrosis and hydroureter, a distended, thick-walled bladder with a keyhole sign suggestive of LUTO, and severe oligohydramnios (deepest vertical pocket 0.59 cm). Maternal renal function and infection screening were unremarkable. After multidisciplinary counseling regarding the guarded prognosis and the local unavailability of fetal therapy, expectant management was undertaken, comprising tocolysis with nifedipine, antenatal corticosteroids, maternal rehydration, and planned amnioinfusion with serial ultrasound surveillance. The patient stabilized and was discharged for close follow-up. This case underscored the central role of prenatal ultrasonography in early recognition of LUTO and the importance of severity-based, multidisciplinary counseling. When severe oligohydramnios presents in the second trimester, the prognosis is guarded, and standardized staging and timely referral to a fetal-therapy center are essential to optimize perinatal outcomes.

Copyright © 2026, The Author(s)
This is an open-access article under the CC BY-SA license

How to Cite: Putra, J. M., Martadiansyah, A., & Bernolian, N. (2026). Prenatal Ultrasound Diagnosis and Conservative Management of Fetal Lower Urinary Tract Obstruction with Bilateral Hydroureteronephrosis and Severe Oligohydramnios at 23 Weeks of Gestation: A Case Report. *Media of Health Research, 4*(3), 451-460. https://doi.org/10.70716/mohr.v4i3.603

Introduction

Fetal lower urinary tract obstruction (LUTO) describes a heterogeneous group of congenital anomalies that share a common prenatal sonographic phenotype: a dilated, thick-walled bladder (megacystis), bilateral hydroureteronephrosis, a dilated posterior urethra producing the characteristic keyhole sign, and, in severe cases, oligohydramnios or anhydramnios (Haeri, 2015; Capone et al., 2022). The reported incidence ranges from approximately 1 in 5,000 to 1 in 25,000 pregnancies, a figure that probably underestimates true frequency because elective termination, intrauterine fetal demise, and postnatally diagnosed cases are inconsistently captured (Haeri, 2015).

Posterior urethral valves (PUV) are the most common cause in male fetuses, followed by urethral atresia or stenosis, whereas female fetuses with LUTO more frequently harbor complex anomalies such as cloacal malformations (Farrugia, 2016; Smith-Harrison et al., 2015). The clinical significance of LUTO derives from its downstream consequences. Obstruction of urinary outflow during a critical window of organogenesis leads to progressive bladder distension, hydroureteronephrosis, compression of the developing renal parenchyma, and reduced amniotic fluid production. Because fetal urine is the principal component of amniotic fluid from the second trimester onward, severe obstruction results in oligohydramnios that disrupts the canalicular phase of lung development and produces pulmonary hypoplasia (Capone et al., 2022; Yamacake & Nguyen, 2013).

Perinatal death occurs in an estimated 35-55% of cases, and end-stage renal disease develops in 24-40% of survivors, with the prognosis being especially poor when oligohydramnios or anhydramnios is detected before 20-24 weeks of gestation (Paraboschi et al., 2024; Capone et al., 2022). Prenatal ultrasonography is the cornerstone of diagnosis, although a definitive anatomical diagnosis is usually only possible postnatally. Where the obstruction is severe and isolated, fetal therapy, principally vesicoamniotic shunting (VAS) and, in selected centers, fetal cystoscopy, may improve perinatal survival, though its benefit on long-term renal function remains uncertain (Nassr et al., 2017; Morris et al., 2013). This report describes a case of fetal LUTO presenting with bilateral hydroureteronephrosis and severe second-trimester oligohydramnios. It uses it as a framework to review the contemporary, severity-based approach to diagnosis, counseling, and management. The report was prepared in accordance with the CARE guidelines for case reports (Gagnier et al., 2014).

Materials and Methods

This study was conducted as a descriptive case report following the CARE reporting guidelines (Gagnier et al., 2014). The subject was a 37-year-old pregnant woman (G3P2A0) referred to Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia, at 23 weeks of gestation because of suspected fetal anomaly and oligohydramnios.

Data collection included maternal history, physical examination, obstetric assessment, laboratory investigations, and serial fetal ultrasonographic evaluations. Fetal biometric measurements, amniotic fluid volume, urinary tract anatomy, and Doppler parameters were assessed using prenatal ultrasonography. Laboratory examinations included complete blood count, renal function tests, liver function tests, inflammatory markers, infectious disease screening, and blood glucose evaluation.

Management decisions were made through multidisciplinary consultation involving maternal-fetal medicine specialists, pediatric urologists, neonatologists, and the patient's family. Clinical outcomes were documented during hospitalization and follow-up planning.

Written informed consent was obtained from the patient for publication of the case and accompanying images.

Results and Discussions

Case Presentation

Patient information and clinical findings

A 37-year-old woman, gravida 3 para 2 abortus 0 (G3P2A0), was referred at an estimated 23 weeks of gestation with a working diagnosis of an intrauterine single live fetus with a suspected congenital anomaly and oligohydramnios. She presented with intermittent lower abdominal pain that had begun approximately three hours before admission. There was no history of vaginal bleeding, leakage of amniotic fluid, trauma, abdominal massage, post-coital bleeding, or use of traditional herbal preparations. She reported a two-week history of yellowish-white, pruritic, malodorous vaginal discharge that had been treated. Fetal movements were still perceived. Her obstetric history included two uncomplicated term vaginal deliveries (2004 and 2012) and one first-trimester miscarriage managed by curettage (2021). There was no family history of hypertension, diabetes mellitus, allergy, or congenital anomalies.

On admission, the patient was alert and hemodynamically stable: blood pressure 120/80 mmHg, pulse 90 beats/min, respiratory rate 20 breaths/min, temperature 36.7 °C, body weight 73 kg, and height 163 cm. General and systemic examinations were unremarkable. Obstetric examination revealed a symphysial-fundal height of 17 cm (one fingerbreadth above the umbilicus), positive external ballottement, irregular uterine activity (one contraction per 10 minutes lasting 20 seconds), and a fetal heart rate of 140 beats/min. Speculum examination showed a livid portio with a closed external os, no active bleeding, and physiological discharge (Figure 1A); a nitrazine (litmus) test was negative for amniotic fluid (Figure 1B). The calculated tocolytic index was low (1), and digital vaginal examination was deferred.

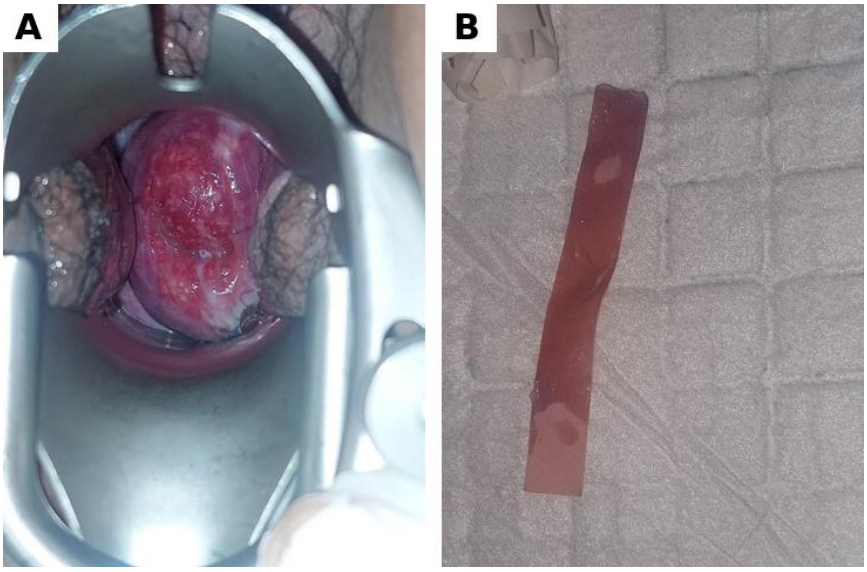

Figure 1. *Clinical examination at admission. (A) Speculum examination showing a livid portio with a closed external cervical os and physiological discharge. (B) Negative nitrazine (litmus) test, indicating intact membranes without leakage of amniotic fluid.*

Diagnostic assessment

The initial obstetric ultrasound on admission demonstrated a single live intrauterine fetus with biometry corresponding to the early second trimester (biparietal diameter 5.37 cm; head circumference 20.73 cm; abdominal circumference 17.73 cm; femur length 3.56 cm; transcerebellar diameter 2.56 cm, ~23 weeks 1 day) and an estimated fetal weight of 476 g. The amniotic fluid was markedly reduced (the single deepest pocket was 0.59 cm), consistent with severe oligohydramnios. The placenta was anterior. A polycystic appearance of the right fetal kidney was initially suspected (Figure 2).

Figure 2. Initial obstetric ultrasonography demonstrating severe oligohydramnios and an initial suspicion of a right fetal renal abnormality (labeled "suspected polycystic kidney").

A targeted fetal anomaly scan performed the following day by a maternal-fetal medicine specialist clarified the diagnosis. It demonstrated bilateral hydronephrosis (right renal calyceal dilatation 1.18 cm; left 2.11 cm) with bilateral hydroureter, together with a distended bladder (megacystis) and a dilated posterior urethra producing a keyhole sign suggestive of LUTO (Figure 3). The umbilical artery pulsatility index was 0.68, and the estimated fetal weight was 600 g. The amniotic fluid remained reduced. The integrated findings were consistent with an intrauterine single live fetus at 23 weeks with bilateral hydroureteronephrosis secondary to suspected LUTO and severe oligohydramnios.

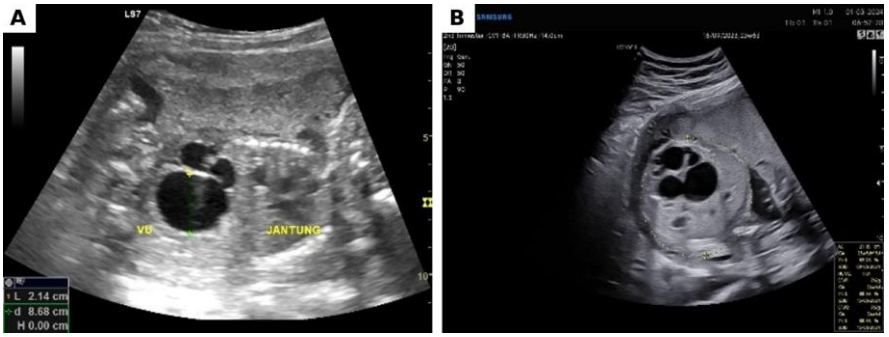

Figure 3. Targeted fetal ultrasonography. (A) Distended fetal bladder (vesica urinaria, "VU") adjacent to the fetal heart. (B) Bilateral cystic dilatation of the renal collecting systems with hydroureter, consistent with hydroureteronephrosis.

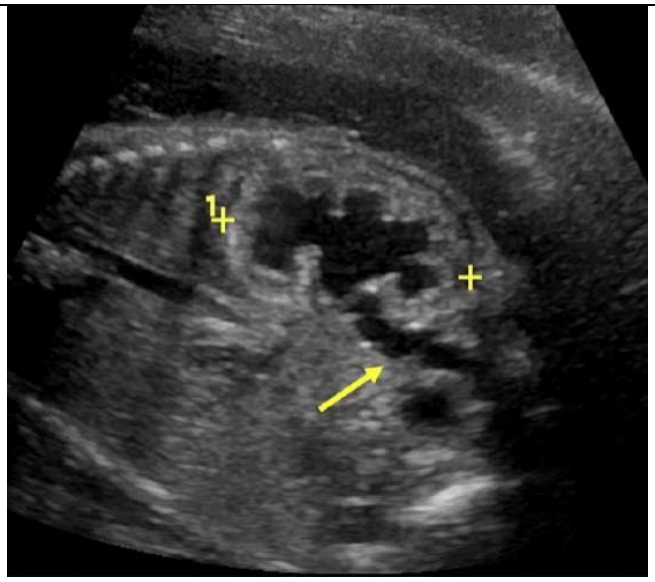

Figure 4. *Ultrasonographic measurement of the dilated, fluid-filled renal pelvis and calyces (calipers and arrow), confirming hydronephrosis*.

Maternal laboratory evaluation was largely unremarkable. There was a mild normocytic anemia (hemoglobin 10.7 g/dL; hematocrit 32%) with a mildly elevated leukocyte count (11.47 × 10^3/mm^3). Renal function was normal (urea 8 mg/dL; creatinine 0.54 mg/dL), as were liver enzymes, electrolytes, albumin, and random blood glucose (87 mg/dL). High-sensitivity C-reactive protein was 3.9 mg/L (reference < 5 mg/L). Infection screening was negative for HBsAg, anti-HIV, and syphilis (VDRL/TPHA). The blood group was O, Rhesus positive. The differential diagnosis of fetal urinary-tract dilatation, with the corresponding imaging features, is summarised in Table 1.

Table 1
Imaging and ancillary findings in congenital anomalies of the urinary tract

Diagnosis	Ultrasound findings	VCUG	Renal scan
UPJ obstruction	Hydronephrosis without hydroureter	Yes	Yes
Vesicoureteral reflux	Variable dilatation; increased pelvic diameter after voiding	Yes	Optional
Posterior urethral valves	Megacystis, thick bladder wall, dilated posterior urethra (keyhole sign), bilateral hydronephrosis	Yes	No
Prune-belly syndrome	Megacystis, bilateral hydroureteronephrosis, irregular abdominal wall	Yes	Optional
Primary megaureter	Ureteric dilatation / hydroureter	Yes	Yes
Multicystic dysplastic kidney	Multiple cysts of varying size; absent normal parenchyma; contralateral hypertrophy	Optional	Optional

UPJ, ureteropelvic junction; VCUG, voiding cystourethrogram.

Diagnosis

Pregnancy at 23 weeks of gestation with threatened preterm labor and an intrauterine single live fetus complicated by a congenital anomaly: bilateral hydroureteronephrosis with suspected lower urinary tract obstruction (LUTO) and severe oligohydramnios.

Therapeutic intervention and follow-up

Management was individualized after multidisciplinary discussion involving maternal-fetal medicine, pediatric urology, and neonatology, and detailed counseling of the patient and her family regarding the guarded fetal prognosis. Because in-utero intervention was not immediately available, an expectant, supportive strategy was adopted. Initial measures comprised monitoring of maternal vital signs, uterine activity, and fetal heart rate; maternal rehydration (3,700 mL/day, given as 2,000 mL intravenously and 1,700 mL orally); and oral nifedipine 10 mg every 6 hours as tocolysis. A complete course of antenatal corticosteroids (intramuscular dexamethasone 12 mg, two doses) was administered for fetal lung maturation, and amnioinfusion with serial ultrasound re-evaluation was planned. Over the subsequent three days, the patient remained clinically stable and pain-free, with resolution of uterine contractions and reassuring fetal heart rates (125-140 beats/min). She was discharged for close outpatient follow-up with planned ultrasound re-evaluation and arrangements for referral to a fetal-therapy center.

Establishing the diagnosis

Bilateral hydroureteronephrosis is rarely an isolated finding and usually reflects an associated genitourinary anomaly; its presence and laterality help localize the level of obstruction (Becker & Baum, 2006; Nguyen et al., 2014). The anatomical level of obstruction can be inferred sonographically: ureteropelvic junction obstruction typically causes pelvicalyceal dilatation without hydroureter; ureterovesical junction obstruction produces hydroureter and hydronephrosis with a normal bladder; whereas bladder-outlet obstruction, the hallmark of LUTO, produces bilateral hydroureteronephrosis combined with a thick-walled, distended bladder (Becker & Baum, 2006; Nguyen et al., 2014). In the present case, the combination of megacystis with a keyhole sign, bilateral hydroureteronephrosis, and severe oligohydramnios was diagnostic of severe LUTO rather than an isolated polycystic kidney as initially suspected, illustrating the value of targeted reassessment by a maternal-fetal medicine subspecialist.

Contemporary consensus statements refine the diagnostic criteria. The European Reference Network for Rare Kidney Diseases (ERKNet) consensus recommends the anteroposterior diameter of the renal pelvis as the most reliable parameter for suspecting obstructive uropathy. It defines first-trimester megacystis as a longitudinal bladder diameter ≥ 7 mm, with a diameter ≥ 15 mm being strongly suggestive of LUTO (Capone et al., 2022). The 2024 international Delphi consensus further endorses imaging features of LUTO, the absence of life-limiting structural or genetic anomalies, a gestational age ≥ 16 weeks, and oligohydramnios (deepest vertical pocket < 2 cm) as candidacy criteria for fetal intervention (Mustafa et al., 2024). A definitive aetiological diagnosis, however, can usually be confirmed only postnatally, by voiding cystourethrography and, where indicated, cystourethroscopy (Haeri, 2015).

Pathophysiology and prognostic significance of oligohydramnios

Fetal urine becomes the dominant contributor to amniotic fluid from the second trimester, which explains why fetuses with severe renal or obstructive pathology may appear unaffected until around 18 weeks (Yamacake & Nguyen, 2013). Adequate amniotic fluid is essential for normal pulmonary development: it maintains the transpulmonary pressure gradient required for alveolar distension and lung growth. Severe early-onset oligohydramnios, as seen in this case (deepest vertical pocket 0.59 cm), permits egress of fetal lung fluid and thoracic compression, culminating in pulmonary hypoplasia, the leading cause of death in severe LUTO (Capone et al., 2022; Haeri, 2015). The timing of oligohydramnios is prognostically decisive: oligohydramnios or anhydramnios before 20-24 weeks is a strong predictor of pulmonary hypoplasia and is associated with a combined perinatal mortality of 60-80% when it develops in the second trimester (Capone et al., 2022; Haeri, 2015).

Risk stratification and prenatal management

Once severe hydroureteronephrosis is detected, a systematic evaluation of the entire urinary tract, amniotic fluid volume, and fetal karyotype/anatomy is required, and consultation with pediatric urology and nephrology is essential to formulate a postnatal plan (Becker & Baum, 2006; Yamacake & Nguyen, 2013). Candidate selection for in-utero therapy has historically followed the algorithm proposed by Johnson, which uses serial vesicocenteses to assess fetal renal function via urinary biochemistry (Johnson et al., 1994). Ruano and colleagues subsequently proposed a practical three-stage prenatal severity classification (Table 2): expectant management is advised for stage I (normal amniotic fluid and renal function); fetal intervention is indicated for stage II (oligohydramnios with preserved renal function) to prevent severe pulmonary hypoplasia and further renal decline; and intervention is not recommended for stage III, in which oligohydramnios coexists with established renal dysplasia or abnormal urinary biochemistry (Ruano et al., 2015; Anderson et al., 2023).

Table 2
Prenatal severity staging of LUTO and corresponding management (adapted from Ruano et al., 2015)

Feature	Stage I	Stage II	Stage III
Amniotic fluid	Normal	Oligohydramnios	Oligo-/anhydramnios
Fetal kidneys	Normal	Hyperechogenic	Hyperechogenic
Cortical cysts/dysplasia	Absent	Absent	Present
Fetal urine biochemistry	Normal	Normal	Abnormal
Recommended approach	Surveillance	Fetal intervention	Intervention not advised

In the present case, the coexistence of severe oligohydramnios with a polycystic/echogenic right kidney raised concern for established renal dysplasia, placing the fetus towards the stage III end of the spectrum, in which in-utero intervention is unlikely to preserve renal function. This assessment, together with the family's wishes and the limited local availability of fetal therapy, informed the decision to pursue expectant management with antenatal corticosteroids, tocolysis, and planned amnioinfusion.

Options for fetal therapy

The principal in-utero interventions are vesicoamniotic shunting (VAS) and fetal cystoscopy (Smith-Harrison et al., 2015; Johnson et al., 1994). VAS, the most widely used intervention, involves the percutaneous, ultrasound-guided placement of a double-pigtail catheter to divert urine from the bladder into the amniotic cavity, thereby decompressing the urinary tract. The randomized PLUTO trial suggested a survival benefit with VAS, although the result did not reach conventional statistical significance in the intention-to-treat analysis (Morris et al., 2013). A subsequent systematic review and meta-analysis found that VAS improved perinatal survival but did not clearly improve longer-term survival or postnatal renal function (Nassr et al., 2017). Fetal cystoscopy permits direct visualization and, in cases of posterior urethral valves, ablation of the obstructing valves; a multicentre case-control study reported a trend towards preservation of renal function with fetal cystoscopy, although it is technically more demanding and carries a urological fistula rate of approximately 10% after laser ablation (Ruano et al., 2015; Sananes et al., 2015). Both procedures are limited by significant complications: shunt dislodgement, occlusion, or migration occurs in more than 40% of VAS cases (Sananes et al., 2015), which explains why the demonstrable benefit of fetal therapy remains modest and why careful candidate selection is essential.

Amnioinfusion and delivery considerations

Amnioinfusion, the instillation of warmed physiological saline or Ringer's lactate into the amniotic cavity, was planned in this case to serve both diagnostic and therapeutic purposes. Diagnostically, restoring amniotic fluid improves sonographic visualization of fetal anatomy; therapeutically, it may relieve uterine pressure, maintain alveolar distension, support fetal lung growth, and reduce the risk of cord compression (Friedman & Ogunyemi, 2018; Hofmeyr & Lawrie, 2012). Recognized contraindications include chorioamnionitis, uterine hypertonicity, lethal fetal anomalies, and severe fetal compromise. For the obstetric team, the decision regarding the timing and mode of delivery requires multidisciplinary input; cesarean delivery is generally reserved for standard obstetric indications or for marked fetal abdominal or bladder distension that could complicate vaginal birth (Nguyen et al., 2014; Becker & Baum, 2006). Preterm delivery has not been shown to improve prognosis and should be avoided in the absence of obstetric indications.

Postnatal considerations and prognosis

The confirmed anatomical diagnosis, along with the presence of obstruction or reflux, guides postnatal management. Many antenatally detected dilatations are asymptomatic, and a proportion of megacystis cases resolve spontaneously, requiring only observation (Fontanella et al., 2017), whereas confirmed PUV requires postnatal valve ablation, and obstructive or persistent refluxing megaureter may require ureteric reimplantation with tapering or plication (Hodges et al., 2010). Overall, the prognosis in this case is guarded and hinges on the earliest possible evaluation and, where appropriate, intervention. The strengths of this report lie in its serial sonographic documentation and its illustration of pragmatic, guideline-concordant decision-making in a resource-constrained setting; its limitations include the absence of fetal urinary biochemistry and karyotyping, which would have allowed more precise severity staging, and the lack of long-term neonatal follow-up. These limitations mirror common challenges in low- and middle-income settings and reinforce the value of early referral to centers with maternal-fetal medicine expertise.

Conclusion

Fetal LUTO with bilateral hydroureteronephrosis and severe second-trimester oligohydramnios is a serious condition with substantial perinatal morbidity and mortality, driven primarily by pulmonary hypoplasia and renal dysplasia. Prenatal ultrasonography enables early recognition, but a definitive anatomical diagnosis usually awaits the postnatal period. Management should be guided by validated severity staging and shared, multidisciplinary decision-making: vesicoamniotic shunting and fetal cystoscopy may improve perinatal survival in carefully selected fetuses. At the same time, amnioinfusion offers diagnostic and supportive value, and surgical correction is reserved for definitive postnatal treatment. Early diagnosis, accurate staging, and prompt referral to a fetal-therapy center are the key determinants of outcome.

Acknowledgments

The authors thank the staff of the Division of Maternal-Fetal Medicine at Dr Mohammad Hoesin General Hospital for their support in the care of this patient. Written informed consent for publication of this report and the accompanying images was obtained from the patient. The authors declare no conflict of interest and received no specific funding for this work.

References

Anderson, T., Oseji, O., Yancey, J., & Bogojevic, A. (2023). Prenatal diagnosis of LUTO: Case report and review of the literature. *International Journal of Pregnancy & Child Birth, 9*(5), 145-146. https://doi.org/10.15406/ipcb.2023.09.00293

Becker, A., & Baum, M. (2006). Obstructive uropathy. *Early Human Development, 82*(1), 15–22. https://doi.org/10.1016/j.earlhumdev.2005.11.002

Capone, V., Persico, N., Berrettini, A., Decramer, S., De Marco, E. A., De Palma, D., … Montini, G. (2022). Definition, diagnosis and management of fetal lower urinary tract obstruction: Consensus of the ERKNet CAKUT-Obstructive Uropathy Work Group. *Nature Reviews Urology, 19*(5), 295–303. https://doi.org/10.1038/s41585-022-00563-8

Farrugia, M. K. (2016). Fetal bladder outlet obstruction: Embryopathology, in utero intervention and outcome. *Journal of Pediatric Urology, 12*(5), 296–303. https://doi.org/10.1016/j.jpurol.2016.05.047

Fontanella, F., Duin, L., Adama van Scheltema, P. N., Cohen-Overbeek, T. E., Pajkrt, E., Bekker, M., … Bilardo, C. M. (2017). Fetal megacystis: Prediction of spontaneous resolution and outcome. *Ultrasound in Obstetrics & Gynecology, 50*(4), 458–463. https://doi.org/10.1002/uog.17422

Friedman, P., & Ogunyemi, D. (2018). Oligohydramnios. In *Obstetric imaging: Fetal diagnosis and care* (2nd ed., pp. 511–515). Elsevier.

Gagnier, J. J., Kienle, G., Altman, D. G., Moher, D., Sox, H., & Riley, D. (2014). The CARE guidelines: Consensus-based clinical case report guideline development. *Journal of Clinical Epidemiology, 67*(1), 46–51. https://doi.org/10.1016/j.jclinepi.2013.08.003

Haeri, S. (2015). Fetal lower urinary tract obstruction (LUTO): A practical review for providers. *Maternal Health, Neonatology and Perinatology, 1*, 26. https://doi.org/10.1186/s40748-015-0026-1

Hodges, S. J., Werle, D., McLorie, G., & Atala, A. (2010). Megaureter. *The Scientific World Journal, 10*, 603–612. https://doi.org/10.1100/tsw.2010.54

Hofmeyr, G. J., & Lawrie, T. A. (2012). Amnioinfusion for potential or suspected umbilical cord compression in labor. *Cochrane Database of Systematic Reviews*, (1), CD000013. https://doi.org/10.1002/14651858.CD000013.pub2

Johnson, M. P., Bukowski, T. P., Reitleman, C., Isada, N. B., Pryde, P. G., & Evans, M. I. (1994). In utero surgical treatment of fetal obstructive uropathy: A new comprehensive approach to identify appropriate candidates for vesicoamniotic shunt therapy. *American Journal of Obstetrics and Gynecology, 170*(6), 1770–1779. https://doi.org/10.1016/s0002-9378(94)70353-1

Kurtz, M. P. (2023). Prenatal diagnoses and intervention. *Urologic Clinics of North America, 50*(3), 351-359. https://doi.org/10.1016/j.ucl.2023.04.006

Koch, A., Sananès, N., & Weingertner, A.-S. (2023). Uropatías obstructivas bajas. *EMC - Pediatría, 58*(3), 1-4. https://doi.org/10.1016/S1245-1789(23)47986-3

Morris, R. K., Malin, G. L., Quinlan-Jones, E., Middleton, L. J., Hemming, K., Burke, D., … Kilby, M. D. (2013). Percutaneous vesicoamniotic shunting versus conservative management for fetal lower urinary tract obstruction (PLUTO): A randomised trial. *The Lancet, 382*(9903), 1496–1506. https://doi.org/10.1016/S0140-6736(13)60992-7

Muñoz, H. (2022). EP20.13: A case report: Urinoma amniotic shunt and other option for LUTO treatment. *Ultrasound in Obstetrics & Gynecology, 60*(S1), 248-249. https://doi.org/10.1002/uog.25517

Munoz, J. L., Tounsi, S., Buskmiller, C., Sanz Cortes, M., Donepudi, R. V., Belfort, M. A., & Nassr, A. A. (2024). Outcomes of fetal lower urinary tract obstruction based on timing of oligohydramnios onset. *Prenatal Diagnosis, 44*(2), 131-137. https://doi.org/10.1002/pd.6493

Mustafa, H. J., Khalil, A., Johnson, S., Gordijn, S. J., Ganzevoort, W., Melling, C., … Nassr, A. A. (2024). Fetal lower urinary tract obstruction: International Delphi consensus on management and core outcome set. *Ultrasound in Obstetrics & Gynecology, 64*(5), 635–650. https://doi.org/10.1002/uog.27684

Nassr, A. A., Shazly, S. A. M., Abdelmagied, A. M., Araujo Júnior, E., Tonni, G., Kilby, M. D., & Ruano, R. (2017). Effectiveness of vesicoamniotic shunt in fetuses with congenital lower urinary tract

obstruction: An updated systematic review and meta-analysis. *Ultrasound in Obstetrics & Gynecology, 49*(6), 696–703. https://doi.org/10.1002/uog.15988

Nguyen, H. T., Benson, C. B., Bromley, B., Campbell, J. B., Chow, J., Coleman, B., … Mevorach, R. (2014). Multidisciplinary consensus on the classification of prenatal and postnatal urinary tract dilation (UTD classification system). *Journal of Pediatric Urology, 10*(6), 982–998. https://doi.org/10.1016/j.jpurol.2014.10.002

Paraboschi, I., Pierucci, U. M., Peycelon, M., Pelizzo, G., & Ruano, R. (2024). Indications and outcomes of fetal cystoscopy for lower urinary tract obstruction: A comprehensive review. *Prenatal Diagnosis, 44*(13), 1539–1549. https://doi.org/10.1002/pd.6709

Ruano, R., Sananes, N., Sangi-Haghpeykar, H., Hernandez-Ruano, S., Moog, R., Becmeur, F., … Favre, R. (2015). Fetal intervention for severe lower urinary tract obstruction: A multicenter case-control study comparing fetal cystoscopy with vesicoamniotic shunting. *Ultrasound in Obstetrics & Gynecology, 45*(4), 452–458. https://doi.org/10.1002/uog.14652

Sananes, N., Favre, R., Koh, C. J., Zaloszyc, A., Braun, M. C., Roth, D. R., … Ruano, R. (2015). Urological fistulas after fetal cystoscopic laser ablation of posterior urethral valves: Surgical technical aspects. *Ultrasound in Obstetrics & Gynecology, 45*(2), 183–189. https://doi.org/10.1002/uog.13379

Shannon, K. J., VanLoh, S., Espinoza, J., Sanz-Cortes, M., Donepudi, R., Shamshirsaz, A. A., Koh, C. J., Roth, D. R., Braun, M. C., Angelo, J., Belfort, M. A., & Nassr, A. A. (2022). Pathological and sonographic review of early isolated severe lower urinary tract obstruction and implications for prenatal treatment. *Ultrasound in Obstetrics & Gynecology, 59*(2), 124-130. https://doi.org/10.1002/uog.23718

Smith-Harrison, L. I., Hougen, H. Y., Timberlake, M. D., & Corbett, S. T. (2015). Current applications of in utero intervention for lower urinary tract obstruction. *Journal of Pediatric Urology, 11*(6), 341–347. https://doi.org/10.1016/j.jpurol.2015.07.012

Yamacake, K. G. R., & Nguyen, H. T. (2013). Current management of antenatal hydronephrosis. *Pediatric Nephrology, 28*(2), 237–243. https://doi.org/10.1007/s00467-012-2240-7