

Role of Ultrasound in Diagnosis and Management of OEIS Syndrome

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Abstract

We will discuss the role of ultrasound in diagnosis and management of OEIS Syndrome and we will present four rare cases of OEIS Syndrome that we diagnosed in last 5 years.

Keywords: OEIS Syndrome; Omphalocele; Bladder Exstrophy; Imperforate Anus; Spinal Defects; Ultrasound

Introduction

OEIS complex (Omphalocele, Exstrophy of bladder, Imperforate anus, Spinal defects), is rare malformative complex of estimated occurrence 1-200,000 - 400,000 live births.

Prenatal Two-Dimensional (2-D) ultrasound plays important role in early diagnosis of OEIS complex and it is the modality of choice to detect this condition prenatally.

For definitive and differential diagnoses, Three-Dimensional (3-D) ultrasound, color Doppler and fetal Magnetic Resonance (MR) can be also used.

Ultrasound findings include major criteria and minor criteria.

The major criteria for the prenatal diagnosis of OEIS include, non-visualization of the fetal urinary bladder between the two umbilical arteries, infra-umbilical abdominal wall defect, omphalocele, Lumbo-sacral myelomeningocele usually skin-covered.

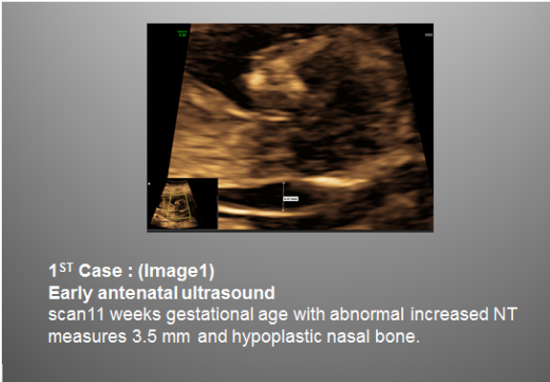
The minor criteria for the prenatal diagnosis of OEIS include, lower extremities malformations, single umbilical artery, renal anomalies, hydrocephalus, widened pubic arches, narrow thorax, and ascites.

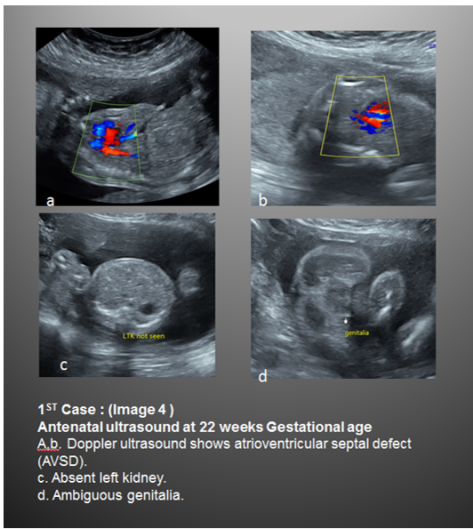
During the early prenatal ultrasound between 12 and 18 weeks of gestation when still there is no well identified lower anterior abdominal wall bulge, low insertion of umbilical cord helps in the early diagnosis of bladder exstrophy.

During the last 5 years we encountered 4 cases of OEIS.

1st Case

31 years old pregnant patient G3P2, has one normal vaginal delivery and one C-section, both babies were normal. Current pregnancy was spontaneous, couples are non-consanguineous. Referred to our radiology department for antenatal ultrasound. Ultrasound shows single viable fetus, GA 11 weeks with abnormal increased NT measures 3.5 mm (Image 1). The patient is referred to Fetomaternal Medicine Unit for further evaluation. Ultrasound in FMU revealed increased NT measures 4.8 mm, hypo plastic nasal bone, abnormal position of both lower limbs, the lower end of the spine is not clearly seen likely absent, the heart appears abnormal likely AVSD, reversed “a” wave in DV. Follow up ultrasound done at 22 weeks Gestational age and revealed, small omphalocele (anterior abdominal wall defect covered with amnion and the umbilical cord typically inserted at the apex), absence of a normal urinary bladder together with the position of the umbilical cord insertion suggest bladder extrophy (Image 2), lumbo-sacral kyphosis (Image 3a), sacral spine deformity (Image 3b), small placenta (Image 3c), abnormal UA Doppler indices at this stage (Image 3d), atrioventricular septal defect (AVSD) of the heart (Image 4a and 4b), absent left kidney (Image 4c) AND ambiguous genitalia (Image 4d) and Fetal findings explained to the couple. Discussed invasive tests CVS and amniocentesis. Discussed NIPT screening for common aneuploidies mainly Trisomy 21. Prenatal testing amniocentesis done at 15 weeks pregnancy, the amniotic fluid sample sent to Cytolab for interphase FISH, Karyotype and Microarray with one sample maternal blood. All the results were normal with Karyotype 46, XY. Then the fetus died at 24 weeks.



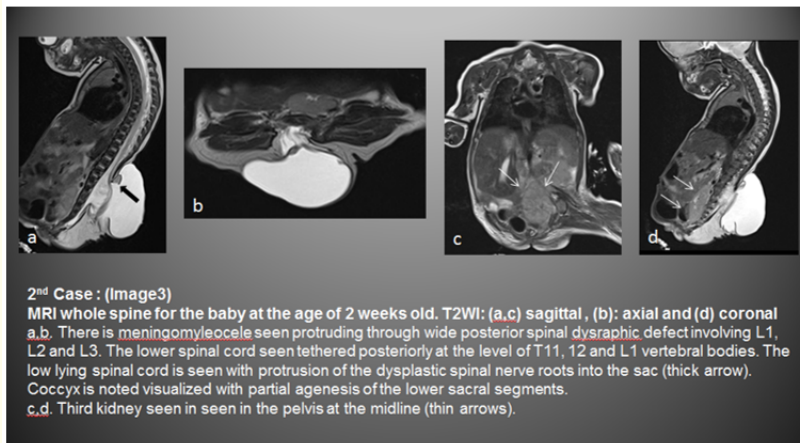


2nd Case

32 years old female patient, G3P2 previous two C-sections referred from private hospital with fetal anterior abdominal wall defect and cystic structure in the lower spinal segment. Ultrasound done in the Fetomaternal Medicine Unit at 30 weeks gestational age and revealed, severe “closed” lumbosacral spinal dysgraphia (Image 1a), major hepato-omphalocele (Image 1b), empty bladder suggesting bladder extrophy and ambiguous genitalia. The findings are discussed in the MDT Meeting by pediatrician, pediatric surgeon, neurosurgeon and obstetrician. Elective CS at 36 weeks 4 days was done. The baby has omphalocele with bladder extrophy and myelocele 4 x 4 cm covered

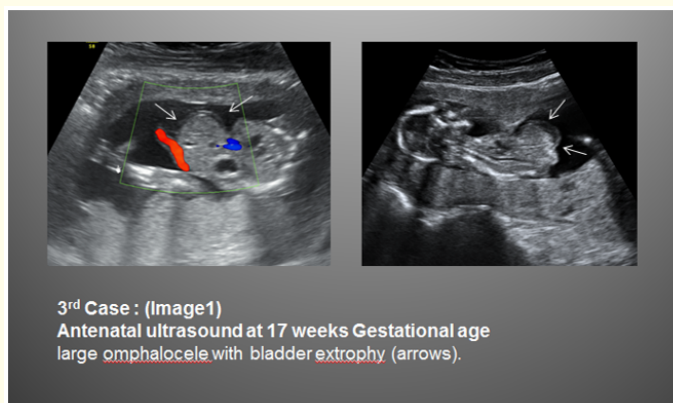
by skin, wet gauze applied on the omphalocele before baby transferred to NICU. The plan was to do surgical repair. X- Ray whole spine done for the baby at the age of 2 days old and revealed widening of inter-pedicular distance, suggesting spina bifida. D4-5 hemi-vertebrae also noted (Image 2). 1st stage surgery done at age of 2 day with cloacal extrophy repair, right Orchiopexy, colostomy and abdominal closure with skin. MRI head and spine were done two weeks later and revealed meningocele protruding through wide posterior spinal dysraphic defect involving L1, L2 and L3, the lower spinal cord is tethered posteriorly at the level of T11, T12 and L1 vertebral bodies, and the coccyx is not visualized (Image 3a and 3b). Third kidney in seen in the pelvis at the midline (Image 3c and 3d). Examination of the head showed small posterior fossa with bilateral tonsillar descend. Surgical repair of the myelocele were done at the age of 1 month. MDT meeting again done including parent, neonatologist, pediatric surgery and neurosurgery. The plan was 2nd stage operation after 6 months to close osteoma and keep bladder back inside abdomen by using synthetic graft. After that, the baby is referred for orthopedic consultation for management of clubfoot and discussion of pelvic osteotomies for bladder/abdominal wall closure. The orthopedic doctors started repeated Ponseti casting for the bilateral clubfeet. By the age of 10 months, old bilateral anterior osteotomies, bladder closure, feeding gastrostomy and dilatation of the colostomy were done. The baby now is about 3 years old and he is doing very well.

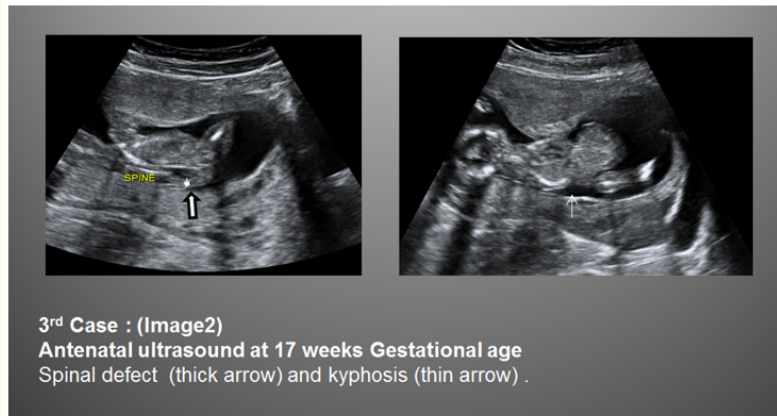




3rd Case

33 years old pregnant patient Primigravida, married 4 years back, this pregnancy is induced through hormonal therapy, came to the radiology department for routine antenatal ultrasound. First ultrasound done and show single intra uterine viable fetus, gestational age 15 weeks 4 days with abnormal fetal spine and large anterior abdominal wall defect. The patient is referred to Fetomaternal Medicine Unit for further evaluation. Ultrasound in FMU at 17 weeks gestational age show large omphalocele with bladder extrophy (Image 1) and spinal defect (open spina pifida as the cisterna magna is not visible and there is deformation of the cerebellum - Bana Sign) and kyphosis (Image 2), the underlying condition is OEIS Syndrome. The patient is reassured and the neonatologist discussed the ultrasound findings and the prognosis with the patient. The findings are discussed in the MDT Meeting. After counseling, the couple decided to terminate the pregnancy. The request for termination of pregnancy due to multiple debilitating structural and congenital anomalies, and it was approved and was submitted to the ethical approval committee. Then the termination of pregnancy done at 18 weeks gestational age. The placenta and fetus was sent for histo-pathological diagnosis.





The surgical pathology report revealed:

- **Fetus:** Around 18 - 20 weeks gestation with cloacal anomaly and associated exomphalos, with abnormal genital and anal development, and short lower body. The appearances suggest an inferior anterior body wall folding defect.
- **Placenta:** Second trimester. This confirms our radiological diagnosis of OEIS Syndrome.

4th Case

30 years old patient, G4P2+1 with previous vaginal delivery, the couple are distant cousins, her nephew with Trisomy 21. The patient is pregnant (gestational age 14 weeks 4 days), this pregnancy is spontaneous, referred from private hospital to Fetomaternal Medicine Unit department for further evaluation of fetal abdominal mass. Ultrasound done in FMU department at 20 weeks gestational age and shows, large abdominal wall defect containing bowel and liver, the urinary bladder was not visualized due to extrophy, the lower end of the spine appears abnormal/absent suggestive of sacral agenesis, abducted thighs with bilateral club feet (bilateral talipes), single Umbilical Artery, and absent left kidney. Ultrasound findings of OEIS Syndrome.

The findings were discussed with the couple as the prognosis is poor and they decided to terminate the pregnancy.

The request for termination of pregnancy was submitted to the ethical approval committee due to multiple serious congenital anomalies with poor fetal outcome, and it was approved. Termination done at 16 weeks of pregnancy. After discussion with the patient, she opted for PN diagnosis (skin and placenta sample) for karyotyping. Chromosomal Microarray Analysis Final Results were normal.

The placenta and fetus was sent for histo-pathological diagnosis. The surgical pathology report revealed:

- **Fetus:** Cloacal anomaly and associated exomphalos.
- **Umbilical cord:** Bivascular.
- **Placenta:** Focal placental disc infarctions, less than 5% of surface area.

Discussion

OEIS is considered one of the rarest and most complex abdominal wall defects with prevalence of 1:200,000 pregnancies and 1: 400,000 live births [1]. OEIS also known as exstrophia splanchnica or exstrophy of the cloaca. The four features of OEIS complex which frequently found together and considered as major criteria for the prenatal diagnosis of OEIS complex are (Omphalocele, bladder exstrophy, imper-

forate anus, and spinal defects) [2,3]. Some findings are considered as minor criteria such as lower extremities malformations, widened pubic arch, renal anomalies, ascites, narrow thorax, hydrocephalous, and single umbilical artery. Some anomalies have been described to happen in association with OEIS complex but rarely such as cardiac anomalies and increased nuchal translucency [4].

Because of OEIS complex is an extremely rare anomaly, its etiology and pathogenesis remain challenge and still unknown. Regarding the etiology, it is rarely reported that OEIS affect patients with family history of similar malformations or with chromosomal anomalies, also OEIS complex has association with environmental or Teratogenic exposures, multiple pregnancies, genetic factors or occur sporadic which is the most frequent etiology. Regarding the pathogenesis, some literatures have been attributed the pathogenesis to many hypotheses such as rupture of the enlarged cloacal membrane before complete descent of the uro-rectal septum resulting in the exstrophy and omphalocele, failure of septations of the cloaca lead to formation of a common cloaca or incomplete fusion of the vertebral lead to formation of open neural defect [5].

Antenatal ultrasound plays important rule in early prenatal diagnosis of OEIS complex, looking for associated anomalies and also plays important rule in the differentiation of OEIS complex from other forms of abdominal wall defects [6]. The main sonographic findings of OEIS complex that are failure to visualize the urinary bladder between the two umbilical arteries, large midline infra-umbilical anterior abdominal wall defect, omphalocele, low insertion of the umbilical cord, and lumbosacral meningomyelocele which usually skin-covered. Other ultrasound findings which could be seen are, anal atresia, ambiguous genitalia, Single umbilical artery (frequent associated sign) and limb defects including abnormal position, such as clubfeet, or missing limb. The maternal serum -fetoprotein (AFP) is always severely elevated in OEIS complex, this help in the diagnosis [7].

OEIS complex can be associated with other anomalies such as, renal anomalies, cardiac defects are described in combination with OEIS complex in only 3 case reports (we have one case) [8]. Increased nuchal translucency, one case only was reported to be associated with OEIS was described (we have one case) [9].

Differential diagnosis includes omphalocele and gastroschisis which appear in ultrasound as herniated bowel in the amniotic cavity however, the presence of normally filled urinary bladder excluded OEIS complex [10]. Color Doppler Ultrasound has been used as a new approach to confirm the diagnosis of bladder exstrophy and its differentiation from omphalocele. Color Doppler findings in exstrophy bladder are visualization of the Umbilical arteries along the sides of bulging mass, alteration in the course of the intra-fetal umbilical arteries and widening of umbilical artery-aorta angle (K angle). Color Doppler findings in omphalocele are normal intra-fetal umbilical arteries course and normal acute umbilical artery-aorta angle (K angle) [11]. Other Differential diagnosis includes include Pentology of Cantrell which can be differentiated by its characteristic anterior thoracic defects in Cantrell's pentalogy and absence of spinal defects, should facilitate differentiation from the OEIS complex. Limb-body wall complex (LBWC) should be considered in the differential diagnosis as there is significant overlap between OEIS and LBWC, however the presence of filled urinary bladder along with severe sclerosis and fissure of the thoracic wall raise the possibility of LBWC. Amniotic band syndrome, Aneuploidy are other differential diagnosis [10].

Once the diagnosis of OEIS complex has made, this require advanced planning by multidisciplinary team of neonatologists, pediatric urologists, pediatric surgeons, pediatric neurosurgeons and pediatric orthopedic surgeons including a radiologist and maternal fetal medicine specialist. Counseling for parents should include the option for pregnancy termination if the manifestations are severe. Counseling for parents should also include discussion about bowel and urinary control as well as the sexual function. The surgical repair of OEIS complex can be done in either as a single procedures or as a staged procedures, with increasing the preference of the stages procedure. The objectives of the treatment include abdominal wall repair to close the omphalocele, separating the bowl from the bladder to create intestinal stoma and urogenital reconstruction to achieve acceptable bowel and urinary control, as well as adequate sexual function [5]. The surgical repair OEIS complex is challenging and the prognosis depends on associated anomalies and its severity as well as the experience of the managing team [12].

Conclusion

The OEIS complex is a rare congenital and complicated condition, with poor prognosis that affects the lower abdominal wall structures of fetus. It is most often diagnosed in second trimester ultrasound by typical sonographic features of omphalocele, bladder exstrophy, imperforate anus and spinal anomalies.

Early prenatal diagnosis can give an option to parents for either termination of pregnancy or to plan appropriately for postnatal management in less severe cases.

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