Prenatal Diagnosis of Fetal Bladder Outlet Obstruction at Songklanagarind Hospital: Report of 5 Cases†

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Abstract

Five cases of fetal bladder outlet obstruction prenatally diagnosed in the Perinatology Unit, Department of Obstetrics and Gynaecology, Songklanagarind Hospital, Songkhla, from January 1990 to September 1999 were reported. Ultrasound findings demonstrated megacystis, various degrees of hydroureter and hydronephrosis and oligohydramnios. Sex could be determined in only four cases and all were male. Chromosome abnormality (trisomy 18) was documented in one case. Postmortem results in three cases established that posterior urethral valves were the cause of obstruction. All cases in our series had poor outcome based on gestational age at first diagnosis, sonographic findings, fetal urinalysis, and chromosome abnormality. Four cases underwent termination of pregnancy and the other resulted in a dead fetus *in utero*. The outcome of some cases may be improved by using the vesicoamniotic shunt placement procedure that increases the likelihood of fetal survival. Therefore, the recommendation is to establish this procedure at Songklanagarind Hospital in the future.

Key word : Bladder Outlet Obstruction, Lower Obstructive Uropathy, Prenatal Diagnosis, Ultrasound

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Bladder outlet obstruction is characterized by progressive accumulation of urine in the bladder as the result of obstruction of urine flow[1]. It constitutes 10 per cent of all fetal obstructive uropathies[2]. The causes of obstruction are posterior urethral valves, urethral stricture, urethral atresia, persistent cloacal syndrome, and megacystis-microcolon-intestinal hypoperistalsis syndrome (MMIH) [1]. Posterior urethral valves, which is a condition unique to male fetuses, is by far the most common cause of lower obstructive uropathies, accounting for 90 per cent of the cases. The incidence is approximately 1 in 10,000 live births[3]. The etiologies of obstruction have different implications for prenatal and postnatal management. The fetus with clearly obstructive uropathy may benefit from antenatal intervention in the form of a vesico-amniotic shunt [4], while the MMIH, which is not a true obstructive uropathy, is a uniformly lethal condition of unknown etiology that primarily affects females[1].

The sonographic signs of bladder outlet obstruction include persistent dilatation of the fetal urethra proximal to the obstruction, progressive dilatation of the bladder, and incomplete voiding. Visualization of a dilated proximal urethra is diagnostic of bladder outlet obstruction, but is not always possible because of fetal positioning, and the urethral dilatation disappears when the bladder becomes markedly distended[1]. The presence of oligohydramnios and megacystis on prenatal ultrasonography is highly predictive of fetal urethral obstruction, making accurate antenatal diagnosis invaluable for subsequent prenatal or early postnatal therapy[5].

There is very little published information on fetal bladder outlet obstruction in Thailand. Therefore, we report our experience with five cases who were prenatally diagnosed as having a fetus with bladder outlet obstruction in the Perinatology Unit, Songklanagarind Hospital, the only referral center in Southern Thailand, from January 1990 to September 1999.

Case 1

A 38-year-old woman, gravida 2, para 1-0-0-1, was sent to our unit for genetic amniocentesis because of advanced maternal age at 16 weeks' gestation. Her previous pregnancy and her family history were unremarkable. An ultrasound scan done prior to the procedure demonstrated a single viable fetus consistent with 15 weeks' gestation with a 4.6 x 4.3 cm intra-abdominal cystic mass and bilateral hydronephrosis. The AP diameter of the left and the right renal pelvis were 11.4 mm and 16.4 mm respectively. No other associated anomaly was detected. Amniotic fluid volume was markedly decreased. The vesicocentesis was performed under ultrasound guidance. Evaluation of the fetal urine revealed osmolarity of 192 mOsm/L, sodium 90 mEq/L, chloride 84 mEq/L, urea nitrogen 9 mg/dl and creatinine 1.4 mg/dl. Since a vesicoamniotic shunt was not available in our institution, our treatment option was limited to serial vesicocentesis. However, after counseling about the treatment options and the prognosis of the baby, the patient still did not wish to terminate pregnancy and refused any form of intervention. Repeated ultrasound examination performed 3 weeks later demonstrated a large cystic mass of 7 cm in diameter and anhydramnios. The fetal kidneys showed renal cortical cysts. The fetus died at 24 weeks' gestation. A macerated male fetus, weighing 875 grams with a markedly distended abdomen was delivered. Chromosome analysis from cord blood was attempted, but failed. The autopsy showed megacystis, bilateral hydronephosis and hydroureter with renal cortical cysts. The cause of obstruction was consistent with posterior urethral valves.

Case 2

A 30-year-old woman, gravida 4, para 1-0-2-1, was referred to our institution at 17 weeks' gestation with sonographic findings of anhydramnios and a fetus with a large intra-abdominal cystic mass. She had had one criminal abortion, one cesarean section of a 2800-gram male baby, and one spontaneous abortion. Her family history was unremarkable. The ultrasound examination performed at our institution demonstrated a single viable fetus with a 7.2 x 5.0 cm intra-abdominal cystic mass occupying the entire abdomen. Both kidneys showed hyperechogenicity of renal parenchyma (Fig. 1). The sex could not be determined. Vesicocentesis was performed under continuous ultrasound guidance. Fetal urinalysis revealed sodium of 103 mEq/L, chloride 107 mEq/L, urea nitrogen 10.7 mg/dl and creatinine 0.7 mg/dl. Cytogenetic analysis using cultured urinary epithelial cells from the aspirated urine failed. In view of the poor outcome based on the prognostic criteria for fetuses with obstructive uropathy, the couple opted to terminate the pregnancy at the referral hospital. No additional information was obtained.

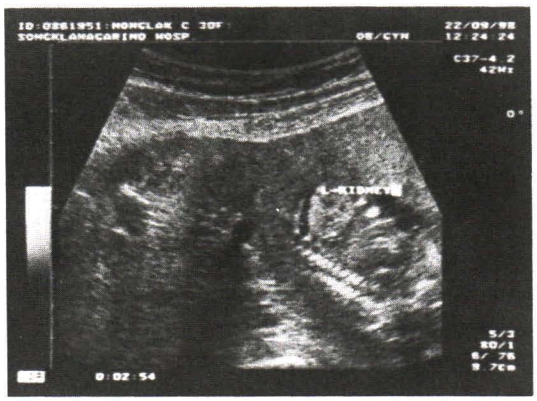

Fig. 1. Ultrasonography of the fetal kidney showing increased echogenicity of renal parenchyma (case 2).

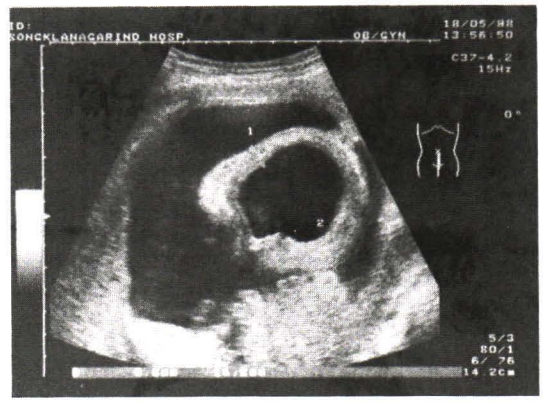

Fig. 2. Ultrasonography showing extensive urine ascites and thick bladder wall (case 3).

Case 3

A 31-year-old woman, gravida 2, para 1-0-0-1, was referred to our institution at 24 weeks' gestation for the presence of a fetal intra-abdominal cystic mass. She was misdiagnosed with an ovarian cyst during pregnancy and had exploratory laparotomy 4 weeks before referral. The operative findings revealed a gravid uterus with normal ovaries. Repeated ultrasound scan demonstrated a single viable fetus with a large intra-abdominal cystic mass and oligohydramnios. The ultrasound scan performed at our institution demonstrated a single viable male fetus in breech presentation consistent with 22 weeks' gestation with a large cystic mass, measuring 14 cm in diameter with urine ascites and a single umbilical artery. Both kidneys showed bilateral hydronephrosis and increased renal echogenicity. No other anomaly was detected. Amniotic fluid volume was markedly decreased. A 22-guage needle was used for intrauterine fetal vesicocentesis under continuous ultrasound guidance. Fetal urinalysis revealed osmolarity of 188 mOsm/L, sodium 96 mEq/L, chloride 98 mEq/L, urea nitrogen 21 mg/dl and creatinine 0.9 mg/dl. Amniocentesis was performed. Cytogenetic analysis revealed a 46, XY karyotype. The follow-up scan performed one week later revealed a single viable male fetus in transverse lie with extensive urine ascites and a thick bladder wall (Fig. 2). After counseling, the couple decided to terminate the pregnancy at the referral hospital. A hysterotomy was performed. The fetus was male with a distended abdomen. However, autopsy was refused.

Case 4

A 28-year-old woman in her first pregnancy was referred to our institution at 20 weeks' gestation due to sonographic evidence of obstructive uropathy. Her past history and family history were unremarkable. The ultrasound scan demonstrated a single viable male fetus consistent with 20 weeks' gestation with a pear-shaped dilated bladder and proximal urethra (keyhole effect) and anhydramnios (Fig. 3). Bilateral hydroureter and hydronephosis were noted along with bilateral renal cortical cysts (Fig. 4). Amnioinfusion was performed with 250 ml of normal saline to facilitate visualization. The amniotic fluid index was 2.8 cm after the procedure. No other associated anomaly was detected. Cordocentesis was done and the result revealed a 46, XY karyotype. Vesicocentesis was performed under continuous ultrasound guidance. Evaluation of the urine revealed sodium of 104 mEq/L, chloride 119 mEq/L, urea nitrogen 21 mg/dl and creatinine 1.0 mg/dl. The fetus had a poor prognosis based on the prognostic criteria for obstructive uropathy. The follow-up scan showed urine ascites, markedly distended bladder, severe bilateral hydroureter, and multiple small renal cortical cysts. The patient opted to terminate the pregnancy at 24 weeks' gestation and delivered a 700 gram stillborn male fetus with a distended abdomen. Autopsy showed three cusp-like folds at the urethra causing urethral obstruction, distention and hypertrophy of the urinary bladder, severe hydroureter, and cystic changes of both kidneys (Fig. 5).

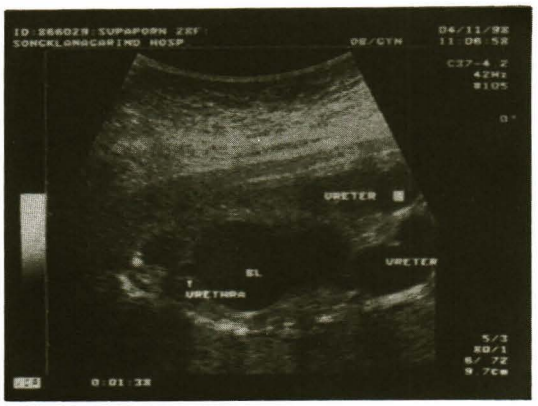

Fig. 3. The fetal bladder and proximal urethra are dilated giving the classic "keyhole" effect. Bilateral hydroureter are also demonstrated (case 4).

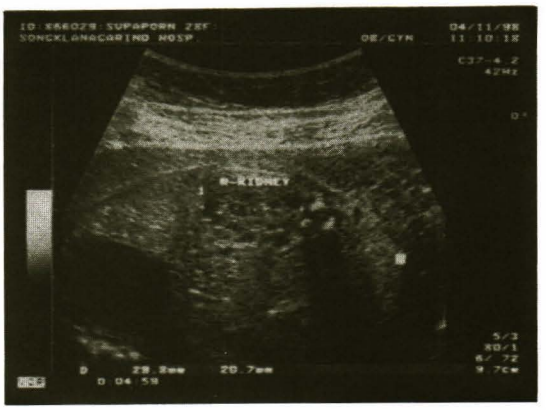

Fig. 4. Ultrasonography of the fetal kidney showing renal cortical cysts (case 4).

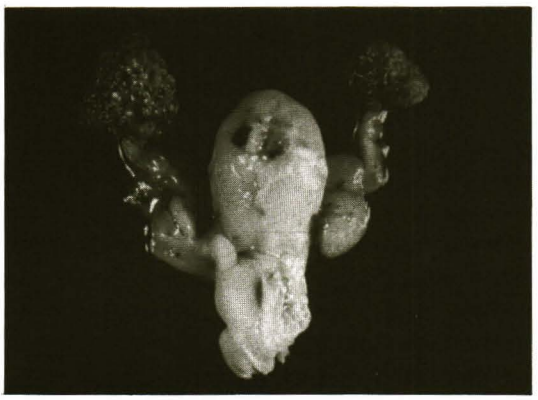

Fig. 5. Postmortem specimen showing distention and hypertrophy of fetal bladder, severe hydroureter and cystic changes of both kidneys (case 4).

Fig. 6. A macerated trisomy 18 male fetus with multiple anomalies including malformation of both forearms, hands, distended abdomen and talipes equinovarus (case 5).

Case 5

A 17-year-old woman in her first pregnancy was referred to our institution at 17 weeks' gestation due to the presence of a fetal intra-abdominal cystic mass. The past history and family history were unremarkable. The ultrasound scan showed a single viable male fetus with multiple anomalies including bilateral choroid plexus cysts, ventricular septal defect, abnormal flexion of wrist joints, malformation of both forearms, megacystis, and talipes equinovarus. The amniotic fluid volume was slightly decreased. Amniocentesis was performed and the fetal karyotype was 47, XY+18. The patient decided to terminate the pregnancy and delivered a dead fetus weighing 170 grams with multiple anomalies as grossly seen in the ultrasound scan (Fig. 6). The whole body X-ray showed absent radius of both forearms and clubfoot. The autopsy established that the cause of obstruction was consistent with pos-

terior urethral valves. Other associated anomalies were the same as the sonographic findings.

DISCUSSION

Bladder outlet obstruction occurs predominantly in males with posterior urethral valves as the most common cause. In our series, the cases in which we could identify the sex of the babies were all male (4/5). Chromosomal abnormality (trisomy 18) was found in one case with multiple anomalies (case 5). The postmortem results in three cases established that posterior urethral valves were the cause of obstruction.

Urethral obstruction results in bilateral hydronephrosis and severe fetal and perinatal morbidity and mortality. Deaths may be due to either renal dysplasia or pulmonary hypoplasia if severe oligohydramnios develops[1,6]. Obstetric management and prenatal counseling are difficult and depend on the evaluation of fetal renal function and the prediction of postnatal outcome. The prognosis can be predicted by gestational age at first diagnosis[7], ultrasonographic evaluation of amniotic fluid volume and renal parenchymal structure, and biochemical analysis of urine[1,6].

Gestational age at first diagnosis is of importance. In general, the earlier the onset of obstruction, the more severe the dysplastic degeneration of the kidney[1,7,8]. Hutton et al reported that detection at or before 24 weeks of gestation predicted a poor outcome with 53 per cent dead or with chronic renal failure at follow-up[7]. All 5 cases in our series were diagnosed before 24 weeks.

Ultrasonograpahic findings can predict the outcome of bladder outlet obstruction. For example, severity of oligohydramnios is strongly associated with pulmonary hypoplasia, which is responsible for 87 per cent of deaths among treated fetuses[1]. In this study, oligohydramnios was noted in all cases except one with trisomy 18 (case 5). The detection of renal cortical cysts in the presence of lower urinary tract obstruction accurately indicates renal dysplasia and irreversible renal damage with specificity and positive predictive value of 100 per cent [9]. In our study, this finding was found in case 1 on a follow-up scan, and case 4. In both cases, autopsy confirmed the sonographic findings. Increased renal echogenicity also correlates with a high probability for renal dysplasia, but is not as accurate as renal cortical cysts. The sensitivity, specificity and positive predictive value were 73 per cent, 80 per cent and 89 per cent respectively[9]. It is also highly predictive of obstructive etiology[10]. This finding was found in case 2 and 3. Poor prognostic indicators in bladder outlet obstruction include absolute oligohydramnios, extensive urine ascites, dystrophic bladder wall calcification, and presence of other congenital anomalies[1]. The prognosis in cases of moderate or severe upper urinary tract dilatation is also poor[11]. Five cases in our series had at least one poor prognostic indicator based on sonographic findings.

Assessment of fetal renal function can be done by evaluation of the electrolyte composition of fetal urine. The poor prognostic value according to Harrison's criteria includes sodium > 100 mEq/L, chloride > 90 mEq/L and osmolarity > 210 mOsm/L[12]. Lipitz et al have shown that sodium, calcium, and beta 2- microglobulin were the best predictors for fetal survival. Beta 2- microglobulin values > 13 mg/L were almost invariably associated with fatal outcome[13]. There is a direct correlation between elevation in urine electrolytes and proteins and the extent of underlying renal histopathological damage[14]. However, urine aspirated from the obstructed fetal urinary tract may be old and not reflective of current fetal renal function. The predictive value of fetal urine electrolyte concentrations and osmolarity may be greater when multiple aspirations of urine from the bladder are done and the trend in their electrolyte concentrations and osmolarity is followed[1]. In our study, 3 of 4 cases (case 2, 3, 4) showed at least one abnormal value of fetal urine electrolytes. In case 1, the values of electrolyte concentrations were quite high, though they did not exceed the cutoff value. However, it showed renal cortical cysts on a follow-up scan, which determined a poor prognosis. If vesicoamniotic shunt was available in our institution, this procedure should be offered before the renal parenchyma becomes irreversible.

Treatment options in fetal obstructive uropathy may be expectant with close observation, preterm delivery, intermittent aspiration, and creation of an intrauterine vesicoamniotic shunt[1]. Creation of an intrauterine vesicoamniotic shunt can be performed in many centers in developed countries. However, in developing countries, such as Thailand, the limitations to be considered are the cost of the instruments and the lack of experienced staff. This procedure should be limited to fetuses with proven obstructive uropathy of a persistent and progressive nature and with known immaturity. Long term out-

come in children after antenatal intervention has been studied[15]. It was found that this procedure might help those fetuses with the most severe form of obstructive uropathy, usually associated with a fatal neonatal course. Intervention in these cases achieves outcomes similar to less severe cases that are usually diagnosed postnatally[15]. However, its efficacy with regard to bladder function remains questionable because shunt placement does not permit regular storage and evacuation, which may be essential for functional bladder development[16]. Complications of vesicoamniotic shunt placement are preterm labour and delivery, premature rupture of the membranes, shunt migration, obstruction, malfunction, urinary ascites and intestinal evisceration [1,17]. However, the benefits do outweigh the risks when a shunt is inserted in some cases.

Current surgical procedures for fetuses with bladder outlet obstruction have significant limitations. Firstly, they are palliative in nature, postponing definite treatment of the obstruction until after birth. Secondly, the incidence of complications of vesicoamniotic shunts is quite high. Thirdly, fetal vesicostomy *via* open fetal surgery has not gained acceptance due to maternal and fetal morbidity. Therefore, a new treatment option has recently been developed. Quintero et al introduced fetal cystoscopy as part of the evaluation of fetuses with low obstructive uropathy[18]. In cases where posterior urethral valves are apparent, direct ablation of the valves can be performed[19]. However, this technique must be performed by experienced clinicians and needs special instruments. The outcome should be carefully evaluated because only a few cases have been studied.

In conclusion, five cases of fetal bladder outlet obstruction prenatally diagnosed in our institution had a poor outcome based on gestational age at first diagnosis, sonographic findings, fetal urinalysis, and chromosome abnormality. We recommend that the intrauterine vesicoamniotic shunt placement procedure be established in our institution in the future to help fetuses who are most likely to benefit from this intervention. In addition, appropriate staff training is essential in order to perform intrauterine fetal therapy.

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การวินิจฉัยก่อนคลอดของทารกที่มีภาวะกระเพาะปัสสาวะอุดตันในโรงพยาบาลสงขลานครินทร์: รายงานผู้ป่วย 5 ราย†

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รายงานผู้ป่วย 5 ราย ซึ่งได้รับการวินิจฉัยก่อนคลอดว่าทารกมีภาวะกระเพาะปัสสาวะอุดตัน ที่หน่วยบริบาลทารกในครรภ์ ภาควิชาสูติศาสตร์และนรีเวชวิทยา โรงพยาบาลสงขลานครินทร์ จังหวัดสงขลา ตั้งแต่เดือนมกราคม พ.ศ. 2533 ถึงเดือนกันยายน พ.ศ. 2542 จากผลการตรวจคลื่นเสียงความถี่สูงพบว่า ทารกเหล่านี้มีกระเพาะปัสสาวะขนาดใหญ่ ท่อไตและกรวยไตโตกว่าปกติ และน้ำคร่ำน้อย สามารถมองเห็นเพศของทารกเพียง 4 ราย ซึ่งเป็นเพศชายทั้งหมด พบโครโมโซมผิดปกติ (trisomy 18) 1 ราย ผลการตรวจศพของทารก 3 ราย พบว่า สาเหตุของกระเพาะปัสสาวะอุดตันเกิดจาก posterior urethral valves ทั้งหมด ผู้ป่วยทุกรายในรายงานนี้มีผลการตั้งครรภ์ไม่ดีโดยพิจารณาจาก อายุครรภ์เมื่อวินิจฉัยได้ครั้งแรก ลักษณะที่เห็นจากการตรวจคลื่นเสียงความถี่สูง ผลการตรวจปัสสาวะทารก และโครโมโซมผิดปกติ ผู้ป่วย 4 รายตัดสินใจยุติการตั้งครรภ์ อีก 1 ราย ทารกตายในครรภ์ ผลการตั้งครรภ์อาจดีขึ้นสำหรับทารกบางราย ถ้าได้ใส่ vesicoamniotic shunt ดังนั้นการใส่ vesicoamniotic shunt ควรจะทำได้ในโรงพยาบาลสงขลานครินทร์ในอนาคต

คำสำคัญ : กระเพาะปัสสาวะอุดตัน, ทางเดินปัสสาวะส่วนล่างอุดตัน, การวินิจฉัยก่อนคลอด, คลื่นเสียงความถี่สูง

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