ROLE OF ULTRASOUND IN PRENATAL DIAGNOSIS OF CONGENITAL URINARY TRACT FETAL ANOMALIES

THESIS

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ABSTRACT

Background: The ultrasound equipment provides the opportunity to identify the urinary tract anomalies prenatally by transabdominal scanning as the kidneys are seen in most patients by 16 to 18 weeks.

Aim of the work: The purpose of this study was to identify the sonographic criteria of urinary tract anomalies and describe the outcome of prenatal detected urinary tract anomalies.

Methods: This was a follow up study of fifty fetuses with urinary tract abnormalities in fetal medicine unit between Jan 2009 and Feb 2010

Each woman was subjected to conventional and detailed ultrasound examination with follow –up every two weeks.

Results: Urinary system anomalies were found in 50 of 1521 with a prevalence of 3.3%, the renal anomalies was the principle reason for termination of pregnancy in 9 cases (18%), in 44 cases (88%) there was full agreement between the ultrasound observation and the postnatal follow up of the cases or autopsy, in 6 cases autopsy finding had not been found by ultrasound examination. so the true positive was 44, the false negative was 6, the sensitivity of ultrasound in diagnosis was 88%.

Conclusions: the outcome of congenital urinary tract anomalies is generally good but these are associated with mortality especially with presence of structural developmental anomalies of the kidneys, Ultrasound diagnosis when made early may prevent additional renal damage by timing of delivery and postnatal treatment.

Key Words:

Ultrasonography**,** urinary tract anomaly, prenatal diagnosis, fetal kidney, congenital anomalies.

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LIST OF ABBREVIATIONS

A Mode	Amplitude mode
AC	Abdominal circumference
ACE	Angiotensien-converting enzyme
ADPK	Autosomal dominant polycystic kidney
AFI	Aminiotic fluid index
AIUM	The American institute of ultrasound in medicine
APD	Antero-posterior diameter
APKD	Adult polycystic kidney disease
ARPK	Autosomal recessive polycystic kidney
B Mode	Brightness mode
BMUS	British medical ultrasound society
BPD	Biparietal diameter
CRL	Crown-rump length
2D	Two dimensional
3D	Three dimensional
4D	Four dimensional
FHR	Fetal heart rate
FL	Femur length
GA	Gestational age
GFR	Glomerular infiltration rate
HC	Head circumference
HCG	Human chorionic gonadotrophin
IPCK	Infantile polycystic kidney
LUTO	Lower urinary tract obstruction
M Mode	Motion mode
MCDK	Multicystic dysplastic kidney
MM	Metanephric mesenchyme
MSD	Mean sac diameter
NT	Nuchal translucency
PNH	Prenatal hydronephrosis
PROM	Premature rupture of membrane
PUV	Posterior urethral valve

RBF	Renal blood flow
SFU	Society of fetal urology
TGC	Time gain control
T-M Mode	Time-motion mode
TVS	Transvaginal sonography
UB	Ureteric bud
UPJO	Uretro-pelvic junction obstruction
VCUG	Voiding cystourethrogram
VUR	Vesico-ureteric reflux

INTRODUCTION

Major and minor congenital anomalies occur in approximately 5% of live born infants this percentage increase to be 20% in stillbirth babies and early neonatal death. Uropathies correspond to 30-50% of all structural abnormalities found at birth the spectrum of malformation is wide and their prognosis is significantly poorer in fetuses with bilateral lesion and decreased volume of amniotic fluid **(Sabbagha et al., 1987)**.

So detection of these anomalies may help to reduce the infant deaths and the rate of admission to pediatric hospital Ultrasound is one of the most important diagnostic tool in diagnosis and some times management of these anomalies.

Urinary tract fetal anomalies are easily diagnosed by ultrasound either by direct visualization of the structural defect or ultrasound markers of chromosomal abnormalities **(Campbell et al., 1993)**.

On the other hand renal pathologies in fetus are often linked to wide spectra of non-nephrological disease, Prenatal diagnosis of these anomalies may significantly affect obstetric management for example Bilateral renal agenesis is commonly associated with breech presentation as well as intrapartum fetal distress due to oligohydramonis and umbilical cord compression given the lethal nature of this renal abnormality.

Prenatal recognition of kidney malformation may also lead to improved long term prognosis, renal function, allows early surgical intervention and preservation of renal function **(Kurjak et al., 2007)**.

Evaluation of fetal bladder and kidney is considered a routine practice in obstetric sonography.

Urine can be identified within the fetal bladder as early as 12 to 13 weeks menstrual age and also fetal kidneys can be visualized sonographically by the same age.

So the relation between renal function and amniotic fluid volume should be addressed.

As in the first trimester amniotic fluid is primarily a perfusion of fetal and maternal serum while after 15 weeks menstrual age fetal urine is the primary source of amniotic fluid **(Chervenak et al., 1993).**

AIM OF THE WORK

The purpose of this study is to review the pathophysiology and sonographic diagnostic criteria of fetal urinary tract anomalies, describe the outcome and evaluate the incidence of fetal urinary tract anomalies in women attending Kasr El-Aini fetal Medicine unit.

Chapter 1:

EMBRYOLOGY AND ANATOMY OF THE GENITOURINARY SYSTEM

Kidneys:

The kidneys lie along the borders of the psoas muscles and are therefore obliquely placed. The position of the liver causes the right kidney to be lower than the left. The adult kidney weighs about 150 g. the kidneys are supported by the perirenal fat (which is enclosed in the (perirenal fascia), the renal vascular pedicle, abdominal muscle tone, and the general bulk of the abdominal viscera. Variations in these factors permit variations in the degree of renal mobility. The average descent on inspiration is 4-5 cm. Lack of mobility suggests abnormal fixation (e.g., perinephritis), but extreme mobility is not necessarily pathologic **(Tanago and Nguyen, 2008).**

On longitudinal section the kidney is seen to be made up of an outer cortex, a central medulla, and the internal calices and pelvis. The cortex is homogeneous in appearance. Portions of it projects toward the pelvis between the papillae and fornices and are called the columns of Bertin, The medulla consists of numerous pyramids formed by the converging collecting renal tubules, which drain into the minor calices at the tip of the papillae **(Aizenstein et al., 1997).**

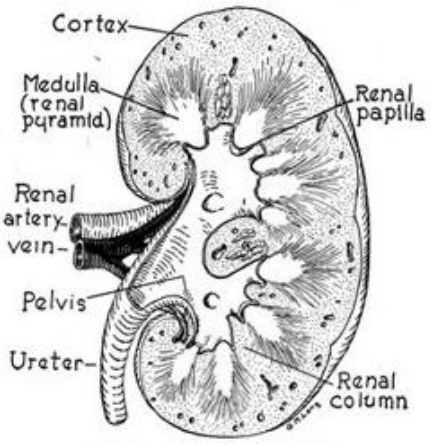

Fig. (1): Cross section of the kidney (www.layyous.com).

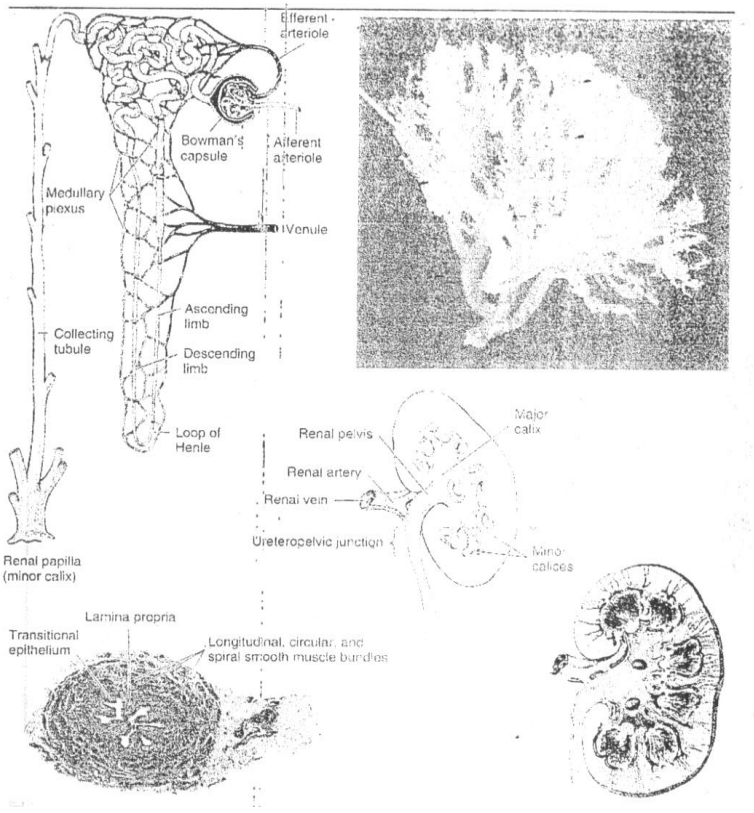

Fig. (2): Anatomy and histology of the kidney and ureter. **Upper Left diagram** of the nephron and its blood supply. **Upper right** the pelvicaliceal system and the arterial supply of the kidney. **Middle** renal calices, pelvis, and ureter (posterior aspect). **Lower left** histology of the ureter the smooth muscle bundles are arranged in both spiral and a longitudinal manner, **Lower right** longitudinal section of kidney showing calices, pelvis, ureter, and renal blood supply (posterior aspect) **(Tanago and Nguyen, 2008).**

The intimacy of the kidneys with intraperitoneal organs and the autonomic innervation they share with these organs explain, in part, some of the gastrointestinal symptoms that accompany genitourinary disease **(Aizenstein et al., 1997).**

Histologically, the functioning unit of the kidney is the nephron, which is composed of a tubule that has both secretory and excretory functions, the secretory portion is contained largely within the cortex and consists of a renal corpuscle and the secretory part of the renal tubule. The excretory portion of this duct lies in the medulla. The renal corpuscle is composed of the vascular glomerulus, which projects into Bowman's capsule **(Tanago and Nguyen, 2008).**

The renal stroma is composed of loose connective tissue and contains blood vessels, capillaries, nerves, and lymphatics **(Chestbrough et al., 1988).**

As regards the blood supply of the kidney, usually there is one renal artery, a branch of the aorta that enters the hilum of the kidney between the pelvis, the renal artery divides into anterior and posterior branches. The posterior branch supplies the mid segment of the posterior surface. The anterior branch supplies both upper and lower poles as well as the entire anterior surface. The renal arteries are all end arteries.

The renal veins are paired with the arteries, but any of them will drain the entire kidney if the others are tied off. Although the renal artery and vein are usually the sole blood vessels of the kidney, accessory renal vessels are common **(Prince, 1998).**

The renal nerves derived from the renal plexus accompany the renal vessels throughout the renal parenchyma **(Aizenstein et al., 1997).** The lymphatics of the kidney drain into the lumbar lymph nodes **(Cockett, 1977).**