Ultrasonographic Screening of Renal Anomalies in Normal Newborns

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Abstract

Birth defects of the renal tract are the most common abnormalities detected. Ultrasound is an accurate imaging method in the evaluation of the urinary tract during early life. This study was performed on 200 potentially normal newborns. Twelve cases were detected by U/S including 2 cases with pelvic kidney, 2 cases with renal duplex, 1 case with PCK disease,1 case with PUV and 6 cases with persistent renal pelvic diameter dilatation ≥1 cm. Ultrasonography is effective for early detection of silent renal anomalies thus allowing for early treatment.

Key words Congenital anomalies of the kidney and urinary tract (CAKUT), screening, ultrasonography.

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Abbreviations

99mTc	Technetium-99m
ACE	Angiotensin converting enzyme
AD	Autosomal dominant
ADPKD	Autosomal dominant polycystic kidney disease
APD	anterior-posterior diameter
AR	Autosomal recessive
ARPKD	Autosomal recessive polycystic kidney disease
Bmp	Bone morphogenetic proteins
BOR	Branchio-oto-renal syndrome
CAKUT	Congenital abnormalities of the kidney and urinary tract
cAMP	Cyclic adenosine mono-phosphate
CDs	Collecting ducts
CDG	Cognitive disorder of glycosylation syndrome
CEC	Central echo complex
CKDs	Cystic kidney diseases
C-myc	C-myelocytomatosis
CNS	Central nervous system
CRF	Chronic renal failure
CT	Computed tomography
DM	Diabetes mellitus
DMSA	dimercaptosuccinic acid
DTPA	diethylenetriaminepentaacetic acid
EGFR	Epidermal growth factor receptor
ESRD	End-stage renal disease
Eya1	Eyes absent 1 gene
F/U	Follow-up
Fgf	Fibroblast growth factor
Foxd1	The forehead/ winged helix transcription factor
Gdnf	Glial-derived neurotropic factor
Gpc3	Glypican 3 glycoprotein
HUN	Hydroureteronephrosis
IVU	Intra-venous urography
MAG-3	Mercaptoacetyltriglycine-3
MCDK	Multi-cystic dysplastic kidneys
MRI	Magnetic resonance imaging
mRNA	Messenger ribosomal nucleic acid

MRU	Magnetic resonance urography
NICU	Neonatal intensive care unit
Odd-1	Odd-Skipped 1 gene
Pax2	Paired box gene 2
PKD	Polycystic kidney disease
PKD1&2	Polycystic kidney disease gene 1&2
PND	Prenatal diagnosis
PUV	Posterior uretheral valve
Rar-alpha&beta	Retinoic-acid receptor family
RCAD	Renal cysts and diabetes syndrome
Ret	Tyrosine kinase receptor
RPD	Renal pelvic diameter
SD	Standard deviation
SFU	Society for Fetal Urology
U/S	Ultrasound
UD Gr	Grade of ureteral dilatation
UPJ	Uretero-pelvic junction
UPJO	Uretero-pelvic junction obstruction
UTI	Urinary tract infection
V2R	Vasopressin V2 receptor antagonist
VCUG	Voiding cysto-urethrogram
VUR	Vesico-ureteric reflux
YAG	Yttrium aluminium garnet laser

Introduction

By renal anomalies we mean disordered renal embryogenesis. Anomalies involving the kidney and urinary system are common. The true incidence of urinary tract anomalies is difficult to ascertain. The reported incidence of many anomalies reflects ascertainment bias because data are often derived from symptomatic individuals (Lee &Diamond, 2009).

Nevertheless, many renal anomalies remain asymptomatic and undiagnosed in early life (Limvongse and Cassidy,2004). Developmental abnormalities of the renal tract accounts for 30% to 50% of end-stage renal disease in children (Seikaly et al; 2003).

Abnormalities which could be observed include hydronephrosis, which is the most common abnormality detected, renal cystic disease, renal agenesis, ectopic kidneys, renal duplex system, lower urinary tract anomalies, and even tumours (Diamond and Peters,2004).

Ultrasound is a safe and accurate imaging method in the evaluation of the urinary tract, and being non-invasive, non-ionizing and a relatively inexpensive examination, it can often make the preliminary diagnosis, stream line the work-up and be used for follow-up studies(Seeds et al.,1986).

With recent improvements in equipment and technical advances in prenatal ultrasonographic diagnosis, kidney and urinary tract anomalies are increasingly detected in utero. However, in oligohydramnios and other rare situations, prenatal

ultrasonographic diagnosis may be unable to detect these congenital anomalies (Tsuchiya et al., 2003).

Also, the recent widespread use of postnatal ultrasound has led to many efforts at screening for congenital kidney and urinary tract abnormalities. However, a standard screening methodology, criteria defining abnormalities and follow-up procedures remain to be established (Yoshida et al.; 2003).

Aim of the work

- Our hypothesis is that urinary tract anomalies are relatively common. The early detection of these anomalies before clinical presentation can save the patient serious morbidities such as repeated urinary tract infection, renal scarring and chronic renal failure.

- The aim of this study is to screen 200 potentially normal Egyptian newborns born in the department of obstetrics, Kasr El-Aini hospital, or presenting for normal check-up in outpatient clinics of Abu-ElReech hospital, in the period from October 2008 to June 2009, for assessment of the value of abdominal ultrasound in the early detection of renal anomalies before renal scarring.

Chapter One

Development of the Kidney (Overview of Human Morphogenesis)

Human kidney development begins at the fifth week of gestation . The first functioning nephrons are formed by week 9. By 32 to 34 weeks, nephrogenesis is completed after which no new nephron units are formed. There is increasing evidence that the number of nephrons formed at birth is a determinant of renal function later in life (Potter et al.; 1972).

Three sets of excretory organs or kidneys develop in the human embryos: the pronephros, the mesonephros and the metanephros. The first set of kidneys (the pronephros) are rudimentary and non functional. The 2nd part of kidneys (the mesonephros) are well developed and function briefly. The third set of kidneys (the metanephros) become the permanent kidneys (Roodhooft et al.;1984)

The metanephros or permanent kidneys begins to develop early in the fifth week and start to function about 4 weeks later. Urine formation continues throughout fetal life. Urine is excreted in the amniotic cavity and mixes with the amniotic fluid (Potter et al.; 1972).

The mammalian kidney derived from two parts of the metanephros. The first part is the ureteric bud (metanephric