

# Bedside ultrasonography screening for congenital renal anomalies in children with congenital heart diseases undergoing cardiac repair

Hussam K. Hamadah<sup>a,\*</sup>, Omar Hijazi<sup>a,c</sup>, Mohammad A. Faraji<sup>b</sup>,  
Mohamed S. Kabbani<sup>a,c</sup>

<sup>a</sup> Section of Pediatric Cardiac ICU, King Abdulaziz Cardiac Center, King Abdulaziz Medical City, Ministry of National Guard–Health Affairs, Riyadh

<sup>b</sup> Section of Pediatric Radiology, King Abdulaziz Medical City, Ministry of National Guard–Health Affairs, Riyadh

<sup>c</sup> King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

<sup>a,b,c</sup> Saudi Arabia

**Introduction:** Ultrasound (US) assessment of renal anomalies in children requiring pediatric cardiac surgery is not a standard practice. This study is highlighting the role of bedside US performed by intensivist to detect occult renal anomalies associated with congenital heart disease (CHD).

**Methods:** A cross sectional study for 100 consecutive children with CHD admitted to Pediatric Cardiac Intensive Care Unit (PCICU) in 2015. US of kidneys screening was performed by trained pediatric cardiac intensivists to ascertain the presence of both kidneys in renal fossae without gross anomalies and to investigate if early detection of occult kidney anomaly would have any impact on outcome.

**Results:** After screening of 100 consecutive children with CHD with renal US, we identified in 94 cases (94%) normal right and left kidney in the standard sonographer shape within the renal fossae. In 6 cases further investigation revealed ectopic kidney in 3 patients (50%), solitary functional kidney in 2 patients (33%) and bilateral grade IV hydronephrosis in one patient (17%). Urinary tract infection developed peri-operatively in 66% of the cases with kidney anomalies with statistical significance compared to patients with normal renal US ( $P: 0.0011$ ). No significant renal impairment was noted in these patients post-surgery. We observed no specific association between the type of renal anomaly and specific CHD.

**Conclusion:** Routine renal US in children with CHD demonstrated prevalence of associated congenital renal anomalies in 6% of children undergoing cardiac surgery. The presence of occult renal anomalies was associated with higher UTI risk. Performing routine renal US as a standard practice in children with CHD is justifiable.

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\* Corresponding author at: Section of Pediatric Cardiac ICU, King Abdulaziz Cardiac Center, King Abdulaziz Medical City, Ministry of National Guard–Health Affairs, Mail Code: 1423, P.O. Box 22490, Riyadh 11426, Saudi Arabia. Fax: +966 11801111x16773.

E-mail addresses: [hamadahmo@ngha.med.sa](mailto:hamadahmo@ngha.med.sa) (H.K. Hamadah), [HijaziO@ngha.med.sa](mailto:HijaziO@ngha.med.sa) (O. Hijazi), [farajimo@ngha.med.sa](mailto:farajimo@ngha.med.sa) (M.A. Faraji), [KabbaniM@ngha.med.sa](mailto:KabbaniM@ngha.med.sa) (M.S. Kabbani).



P.O. Box 2925 Riyadh – 11461KSA  
Tel: +966 1 2520088 ext 40151  
Fax: +966 1 2520718  
Email: [sha@sha.org.sa](mailto:sha@sha.org.sa)  
URL: [www.sha.org.sa](http://www.sha.org.sa)



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**Keywords:** Renal ultrasound, Congenital renal anomalies, Congenital heart disease

## Introduction

Congenital heart disease (CHD) is the most common congenital disorder in newborns with a reported prevalence of 6 to 13 per 1000 live births [1,2], while the incidence of urinary tract malformations (UTM) was ascertained as 0.48% [3]. There are some preferential associations of UTM with intestinal defects, severe ear defects, central nervous system and heart defects [4]. Some authors reported that children with urinary tract anomalies have ten times greater incidence of CHD (8/100) compared to children in the general population (8/1000) [4]. In another series of 453 infants and children with UTM, 34 patients (8%) had CHD [5]. The symptoms of renal anomalies are usually silent, although there are some clues that may indicate the possible presence of these malformations such as the presence of single umbilical artery at birth, development of urinary tract infection (UTI), a history of oligohydramnios, external ear abnormalities [6] or suspected anomaly by antenatal ultrasound (US).

Association of CHD with extra cardiac malformations is ranging between 11–45% in autopsy findings and 11.4–29% in clinical studies [7]. The potential risk for acute renal injury and safety of cardiac surgery using cardiopulmonary bypass are particularly of great concern in the vulnerable small infants and neonates with renal anomalies requiring open-heart surgery [8].

Routine renal ultrasound screening prior to pediatric cardiac surgery is a routine practice in some tertiary centers but till now is not considered a recommended standard of care. In order to evaluate the prevalence of occult renal anomalies in association with CHD and to evaluate their effects on cardiac surgery, we conducted this prospective study to look for the presence of renal malformations and to assess the post-operative course of these children undergoing cardiac repair.

## Material and methods

After obtaining informed consent and ethics committee approval from the Institutional Research Board of King Abdullah research center-King Abdulaziz Medical City IRBC/819/15; We conducted a cross sectional study for 100 con-

### Abbreviations

|       |  |
|-------|--|
| AKI   | Acute Kidney injury                    |
| CPB   | cardiopulmonary bypass                 |
| CHD   | Congenital heart disease               |
| PCICU | Pediatric Cardiac Intensive Care Unit  |
| RACHS | Risk Adjusted Congenital Heart Surgery |
| US    | Ultrasound                             |
| UTI   | Urinary Tract Infection                |
| UTM   | Urinary tract malformations            |

secutive children with no previous renal ultrasound who were admitted after cardiac surgery to PCICU from January 1st, 2015 till April 1st 2015.

The following data were collected for patients with renal anomalies in this study: Demographic information (age, weight, and gender), type of CHD, type of surgical procedures, bypass time, aortic cross-clamp duration, length of PCICU and hospital stay, evaluating specific outcome measures such as development of Acute Kidney injury (AKI) through monitoring peri-operative renal function (BUN, serum creatinine levels and urine output), the incidence of urosepsis and the need of peritoneal catheter or dialysis. Renal US was initially performed by trained PCICU intensivists and confirmed by radiologists. We followed an algorithm (Fig. 1) to confirm first the presence of both kidneys in normal position in renal fossae and then to assess the size and gross morphology of the kidneys. We used a General Electric (GE) ultrasound machine. Since most of the included populations were infants, we used transducer (8C) curvilinear probe with frequency 8–12 MHz. Depth was adjusted to get optimal image size (5–10 cm). While the patient was lying in supine position views were taken in sagittal plane with placing the probe in the lower intercostal space between anterior and posterior axillary lines; the marker was directed to 12 and 9 O'clock to get longitudinal and traverse views respectively (Fig. 2). Renal ultrasound training of intensivists and fellows was achieved by attending and performing a minimum of (10) cases of bedside focused renal ultrasound under supervision of expert radiologist and technician, in addition to review different archived cases stored in hospital library which

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