Relationship between skin to stone distance on computed tomography (CT) and clearance rate after ESWL

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

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Mohamed Ismail Atya

List of Contents

List of Tables

List of Figures

List of Figures

List of Figures

List of Abbreviations

Abb.	Full term
B2M	Beta2 microglobulin
BGAL	B-galactosidase
CIRF	Clinically insignificant residual fragments
CT	Computed tomography
ESWL	Extracorporeal shockwave lithotripsy
GFR	Glomerular filtration rate
GI	gastrointestinal
HM	Human model
HU	Hounse field
IVU	Intravenous urography
MRI	Magnetic resonance imaging
NAG	N-Acetyl-b-D-glucosaminidase
PCN	Percutaneous nephrostomy
PCNL	Percutaneous nephrolithotomy
RI	resistive index
SD	Standard deviation
SD	Stone density
SF	Stone free
SSD	Skin to stone distance
SW	Shockwave
UNHC	Unenhanced helical CT
US	Ultrasound
UTI	Urinary tract infection

INTRODUCTION

Patients with urolithiasis constitute an important part of everyday urological practice. The optimal clinical management of this disease requires knowledge of the diagnostic procedures, the rational treatment of acute stone colic, stone expulsive treatment and the modern principles of stone removal. Management of renal stones includes pharmacotherapy, extra corporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and open surgery ***(Tiselius et al., 2011).***

Since the introduction of ESWL by ***Chaussy in (1980),*** the therapeutic strategy for urolithiasis has completely changed. Dr. Christain Chaussy of the University of Munich was the first to treat renal stone in humans using a new concept termed extracorporeal shock wave lithotripsy. Using this technology, he determined that patients could have renal or ureteral stones removed without the need of an incision or skin puncture. Due to its non invasiveness, the concept quickly gained widespread and became the treatment of choice for the vast majority, of urinary stones. The first lithotripter model (Dornier hm-1) was soon replaced by the HM-2 IN 1982, and the HM-3 in 1984. The HM-3 was first used in the United States on February 23, 1984 at Methodist Hospital in Indianapolis. Since its introduction by ***Chaussy et al. in (1980)***, it has become the preferred treatment for renal & upper ureteric calculi of <2 cm in diameter. The outcome of ESWL depends on many factors, including stone size, location, composition, density (Hounsfield unit: HU), Voltage (KV), and the number of shocks delivered. Skin to stone distance (SSD) ***(Tan et al., 2002).***

In 2005, Smith introduced helical computerized tomography (CT) as an alternative to intravenous pyelography and it has now become the gold standard for diagnosing both renal and urinary calculi, thanks to its high sensitivity (95%) and specificity (98%) ***(Stuart et al., 2009).***

In recent years, CT has gained popularity and has rapidly been establishing itself as the investigation of choice in the imaging of kidney stones. The technique for maximizing information with respect of both renal and ureteric stones is well described. No oral or intravenous contrast is used and a spiral scan is performed from the kidneys up to the symphysis pubis. Usually 5 mm reconstructions are used, but finer reconstructions are possible and should be used when looking for smaller stones ***(Rao, 2004).***

Non contrast CT provides valuable information confirmative of anatomic abnormalities, in addition to the basic information regarding stone location, size, shape, density, and skin-to-stone distance (SSD). Lately, several experiments assessing the connection between information from the medical field and the efficacy of ESWL have been conducted, and Hounsfield unit (HU), SSD, and stone size have all been identified as key factors in connection with the success of ESWL. In the present study, we attempted to determine and describe the most important clinical information collected via NCCT regarding the ESWL stone-free rate ***(Park et al., 2012)***.

Skin – to – stone distance can be readily measured by CT scan some studies showing relation between ESWL stone – free rate and SSD in renal stone patients. SSD may therefore be a useful clinical predictive factor of the success of ESWL on renal stones***(Park et al., 2012)***.

AIM OF THE WORK

To determine whether the distance from skin to stone, as measured by computed tomography (CT) scans, could affect the stone – free rate achieved via extracorporeal shock wave lithotripsy (ESWL) in renal stone patients.

Chapter One

FOCUS ON PELVICALYCEAL SYSTEM ANATOMY

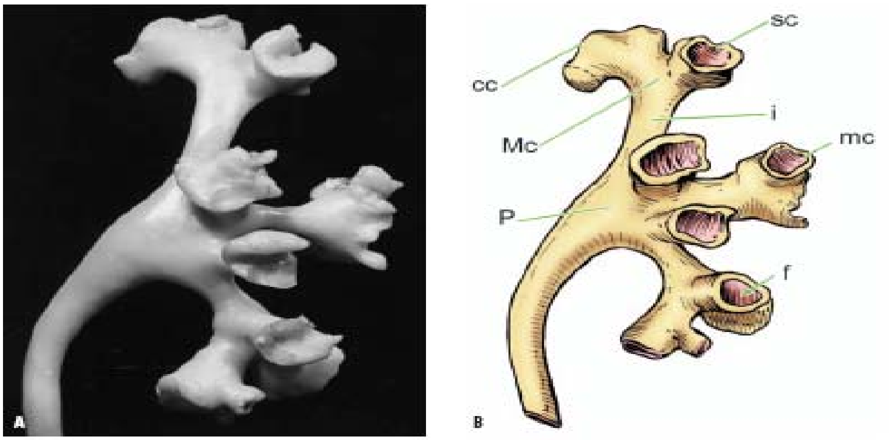

Fig. (1): (A): Anterior view of a pelviocaliceal endocast from a left kidney, obtained according to the injection-corrosion technieques. (B): Schematic drawing of the endocast shown in A, indicates the essential elements of the kidney collecting system. cc-compound calyx; sc-single calyx; mc- minor calyx; Mc-major calyx: f-caliocal fornix ***(Quated from Abd El Ghani MD thesis, 2008).***

Basic intrarenal anatomy:

The renal parenchyma consist of two kinds of tissue, the cortex and medulla. On longitudinal section the cortex forms the external layer. The renal medulla formed by inverted cones surrounded by cortical tissue on all sides (except at the apices) ***(Sampaio, 1993).***

In a longitudinal section, the medullary cone called (renal pyramid). The apex of renal pyramid called (renal papilla). The layers of cortical tissue between adjacent pyramids called renal columns (cortical columns of Bertin) ***(Kaye et al., 1982).***

A minor calyx is defined as the calyx that is in immediate apposition to a papilla. The minor calices range in number from 5 to 14. A minor calyx may be single (drains one papilla) or compound (drains two or three papillae). The polar calices often are compound. The minor calices may drain straight into an infundibulum or join to form major calices which will drain into an infundibulum. Finally, the infundibula drain into renal pelvis (figs. 1) ***(Sampaio et al., 1988).***

Classification:

- Group A:

In this group pelvicalyceal system is composed of two major calyceal groups (superior and inferior)as aprimary divisions of renal pelvis and a midzone calyceal drainge dependent on these two major groups.

Type A-1 midzone is drained by minor calyces that are dependent on the superior or the inferior or even both calyceal groups simultaneously (fig.2, A).

Type A-2 midzone is drained by crossed calices, one draining into superior, another one to inferior calyceal group simultaneously (fig.2, B). ***(Sampaio, 1993).***