بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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جامعة عين شمس

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MONA MAGHRABY

Stone Heterogeneity Index as a New Parameter for Prediction of Shockwave Lithotripsy Outcomes

Thesis

Submitted for Partial Fulfilment of

Doctorate Degree in Urology

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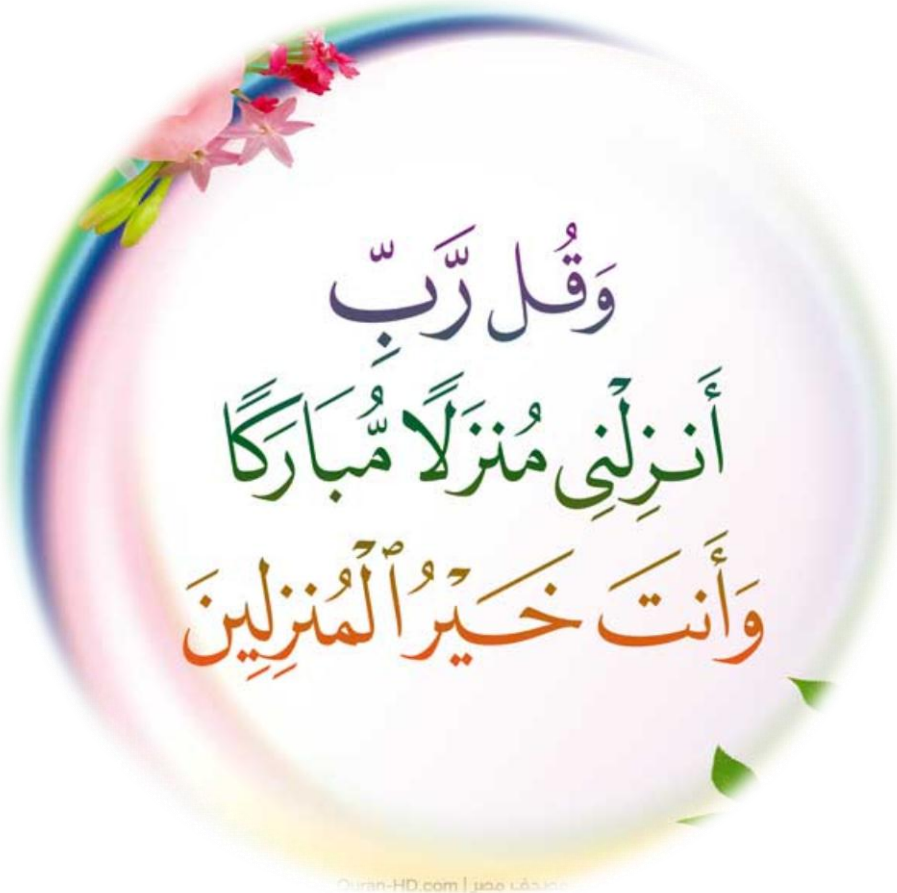
وَقُل رَّبِّ
أَنزِلْنِي مُنزَلًا مُّبَارَكًا
وَأَنتَ خَيْرُ الْمُنزِلِينَ

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Abd El Rahman Hossam Mahmoud Nasef

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List of Abbreviations

Abb.	Full term
AUA	*American Urological Association*
CBC	*Complete blood count*
CT	*Computed tomography*
DECT	*Dual–energy CT*
EAU	*European Association of Urology*
EHLs	*Electrohydraulic lithotripter*
ESWL	*Extracorporeal shockwave lithotripsy*
HM3	*Dornier human model 3*
HU	*Hounsfield unit*
HUs	*Hounsfield units*
IEC	*International electrotechnical commission*
IQR	*Inter-quartile range*
MPA	*Megapascals*
MSD	*Mean stone density*
NCCT	*Non–contrast computed tomography*
PUJ	*Pelvi-ureteric junction*
ROI	*Region of interest*
SHI	*Stone heterogeneity index*
SPSS	*Statistical Package for Social Science*
SSD	*Skin-to stone distance*
SWL	*Shock wave lithotripsy*
URS	*Ureteroscopic lithotripsy*
VCSD	*Variation coefficient of stone density*

INTRODUCTION

Extracorporeal shock wave lithotripsy (SWL) is the most common mode of therapy for small renal and ureteral stones. Stones are first disintegrated by shock waves, and then fragments are spontaneously cleared from the urinary tract. Several stone characteristics including stone size, mean stone density (MSD) and skin to stone distance (SSD) have been suggested to optimize and predict SWL outcomes ***(El-Nahas et al., 2007).***

Examining stone fragility is important to identify patients who will benefit from SWL and avoiding unnecessary exposure of the renal parenchyma to shock waves as well. Failure of stone disintegration results in the requirement of an alternative treatment procedure which increases medical costs ***(Andrabi et al., 2015)***.

Mean Stone Density (MSD) has been widely used during the last decade as an important parameter to characterize urinary stones susceptibility to SWL for both research and clinical practice. However, stones often comprise a combination of crystals and MSD is only an arithmetical average that cannot represent the heterogeneity of stone composition ***(Park et al., 2014).***

MSD is the mean value of the Hounsfield units (HUs). Hounsfield units (HUs) can be measured on the magnified axial

non-contrast computed tomography (NCCT) images from the point of the largest stone diameter whereby an imaginary elliptical region of interest drawn incorporating the largest cross sectional area of the stone. Additionally, NCCT can provide other pixel statistics such as the minimum, maximum and standard deviation of HU values ***(Tanaka et al., 2013)***.

As the composition of urinary stones can vary even though they have a similar MSD, Lee et al., postulated that a heterogeneous stone may be more fragile than a homogenous stone and therefore identification of such stones prior to SWL can predict favorable results. Lee et al., study defined stone heterogeneity index (SHI) as the standard deviation of stone density on NCCT that can be a novel predictor for SWL outcomes. SHI was independently associated with SWL success in patients with urinary calculi, thus SHI can be a useful clinical parameter for stone fragility ***(Lee et al., 2016).***

The relationship between stone compositions and density of stone has been accomplished by in vitro studies showing uric acid calculi (easily fragmented with SWL) having the least density (112-436HU) and calcium oxalate monohydrate (often refractory to SWL) having the highest density (1743-2857HU) ***(Rabani and Moosavizadeh, 2012)***.

However, further prospective studies are needed to confirm the observation on the relationship between SHI and SWL outcomes to determine a clinically applicable cut-off

value of SHI for the selection of proper SWL candidates. SHI will play a promising role when determining a treatment modality in patients with a urinary stone and especially when selecting the proper SWL candidates from the patients with a stone of large size or high MSD ***(Lee et al., 2016).***

Aim of the Work

The aim of this work is to introduce the concept of stone heterogeneity index (SHI) as the standard deviation of stone density on non-contrast computed tomography and investigate whether SHI can be a predictor for SWL outcomes.