Original Article

Lithotripsy

A Prospective Study of Extracorporeal Shock Wave Lithotripsy (ESWL) Induced Hypertension in Lahore Division, Pakistan

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ABSTRACT

Objective: Our aim was to evaluate the hypothesis in a randomized clinical trial, whether extra- corporeal lithotripsy (ESWL) causes any blood pressure change, in subjects with different genders having normal blood pressure and kidney lithiasis.

Study Design: A descriptive cross sectional study.

Place and Duration of Study: This study was carried out at the Department of lithotripsy, Khan Kidney Hospital and King Edward Medical University, Lahore from February 2012 to January 2013.

Material and Methods: Adult patients (≤ 60 years old) were randomized to receive immediate ESWL versus observation. The trial included 100 patients with small (<20 mm) asymptomatic renal pelvic stones who were randomized to undergo ESWL. There were 25 male subjects (ESWL group A), 25 male subject (Control male group B), 25 female subjects (ESWL group C) and 25 female patients (Control female group D). Patients were evaluated by measure of the systolic and diastolic pressure before and after lithotripsy (immediately after the procedure & after 3 months of ESWL treatment). Hypertension was considered when diastolic pressure was greater than (≤90 mm/Hg). Blood pressure was recorded by using a standardized protocol. The amount of shock waves applied in each case ranged from 1500-6000, with the mean of 4000 shock waves at the median intensity of 15 kv. Patients were then followed up for measurement of blood pressure immediately after the treatment and after 3rd month. The rate of on set of hypertension was evaluated for all groups.

Results: There was statistical significant difference in the incidence of hypertension between treated groups and observed groups.

Conclusion: In this randomized controlled clinical trial, there was significant evidence that ESWL causes significant change in blood pressure (i.e. 12% in male group and 8% in female group).

Key Words: Extracorporeal shock wave lithotripsy (ESWL), Kidney damage, Hypertension (HTN)

INTRODUCTION

Since its 1st presentation in Germany in 1980[1], extracorporeal shock wave lithotripsy (ESWL) has revolutionized the treatment of urinary lithiasis because of its ease of use and noninvasive nature[2]. ESWL acts via a number of mechanical and dynamic forces on stones such as cavitation, shear and spalling[3,4]. The idea of this procedure is to generate high intensity (shock waves) outside the patient and then to focus them on the stone to fragment it. However, the existence of both short and long term damage to the renal parenchyma after ESWL is well documented[5] due to the trauma of thin walled vessels in the kidney and adjacent tissues, which can result in hemorrhage[6], release of cytokines and infiltration of tissues by inflammatory cells. They may lead the formation of scar and possible chronic loss of renal tissue[7]. Histopathological examination of human and animal kidneys showed endothelial cell damage to midsized arteries, veins, and glomerular capillaries immediately after ESWL[8,9].

In 1987, two independent studies reported an excess incidence of hypertension of 8% in patients following ESWL[10,11] and controversy about changes in blood pressure after ESWL has continued.

MATERIALS AND METHODS

A total of 150 subjects referred to study, 125 were recruited based on inclusion and exclusion criteria. A total of 125 subjects entered the study after giving informed consent. A letter was sent to all subjects asking them to return hospital for follow up. 100 of these completed the study protocol. Thus trial included 100 adult patients (≤60 years old at the time treatment) with small asymptomatic renal pelvic stones (<20 mm). There were 25 male subjects (ESWL, group A), 25 male subject (Control male group B), 25 female subjects (ESWL group C) and 25 female patients (Control female group D). Patients were evaluated by measure of the systolic and diastolic pressure before and after lithotripsy (immediately after the procedure & after 3 months of ESWL treatment). Patients were included if they were; asymptomatic or minimally symptomatic with single or multiple pelvic stones of a combined diameter of 20 mm in one renal unit. Patients with known hypertension, diabetes mellitus, bleeding disorders, pregnancy, obesity (body weight > 100 kg)

and decreased renal function were excluded from the trial.

Lithotripsy: A biplane fluoroscopic guided electro-hydralic lithotripter made by Shenzhen HighTech Medical Equipment China was used. 1500 to 6000 shock waves were applied to each patient (with the mean of 4000) for 20-60 min, with the peak value of the potential pulse ranged from 12 to 19 kv[12] with the median intensity of 15 kv.

Blood Pressure Measurement: The pretreatment and follow up (immediate after lithotripsy and 3 months after lithotripsy) measurements of blood pressure (BP) were taken by the investigator according to a standardized protocol, using a mercury sphygmomanometer on the patient's right arm, with the patient laying supine for at least 5 minutes; the pressure was raised to above the disappearance of a palpable radial pulse and then the cuff deflated gradually while auscultating the appearance of the 1st Korotkoff sound and disappearance of the 5th Korotkoff of the pulse in the brachial artery after 5 min of rest[13]. Three measurements were done in succession, separated by 2 min, and average value of systolic and diastolic blood pressure was recorded. The dominant arm was always used.

Other Evaluations: The other baseline investigation included intra venous urogram (IVU), blood renal function tests, and complete urine analysis.

Statistics: The results were expressed as mean ± SD. For statistical analysis paired t-test was used and p value <0.005 was considered statistically significant.

RESULTS

At the start of trial pre ESWL mean systolic blood pressure of subjects from A, B, C, & D were 132 ± 10, 132 ± 7, 133 ± 8 & 135 ± 6 mmHg respectively. No significant difference was observed between the mean systolic BP of male treated group (A) versus male control group (B), p value being 0.99. There was also no significant association between female treated group (C) and its control group (D), P value being 0.322.

Mean diastolic BP at the beginning was 73 ± 6, 74 ± 5, 73 ± 6 & 73 ± 5 mmHg in groups A, B, C, & D respectively. No significant difference was observed among the mean diastolic BP of male and female groups, p value being 0.52 & 0.99 respectively.

Post ESWL systolic BP (immediately after the treatment) showed the mean of 137 ± 8 & 132 ± 8 mmHg in groups A & B respectively. Significant difference was observed between the mean systolic BP of male treated group (A) versus male control group (B), p value being 0.03. (Table; 01)

Post ESWL systolic BP (immediately after the treatment) showed the mean of 139 ± 8 & 133 ± 8 mmHg in groups C & D respectively. Significant difference was observed between the mean systolic BP of female treated group (C) and female control group (D), p value being 0.01. (Table; 02)

Mean diastolic BP immediately after the treatment with ESWL was 87 ± 7, 74 ± 5, 85 ±7 & 76 ± 5 mmHg in groups A, B, C & D respectively. Significant difference was observed among the male treated group (A) and its control group (B), p value being 0.00001. There was also significant association between female treated group (C) and female control group (D), p value being <0.001. (Table; 1 & 2)

Systolic blood pressure readings after 3 months of ESWL treatment showed the mean of 138 ± 9 & 133 ± 13 mmHg in groups A & B respectively. Significant difference was observed between the mean systolic BP of male treated group (A) versus male control group (B), p value being 0.01. (Table; 01)

Systolic pressure readings after 3 months of ESWL treatment showed the mean of 138 ± 8 & 132 ± 9 mmHg in groups C & D respectively. Significant difference was observed between the mean systolic BP of female treated group (C) and female control group (D), p value being 0.01. (Table; 02)

Mean diastolic BP after the 3 months of treatment was 84 ± 7, 75 ± 10, 84 ± 8 & 76 ± 10 mmHg in groups A, B, C & D respectively. Significant difference was observed among the male treated group (A) and its control group (B), p value being 0.0006. There was also significant association between female treated group (C) and female control group (D), p value being 0.003. (Table; 1&2)

At the end of trial a total of 03 (12%) male subjects and 02 (8%) female patients had developed hypertension after ESWL for which medication was administered.

Table No.1; Correlation of systolic & diastolic blood pressure before, immediately after and on 3rd month post extra corporeal shock wave lithotripsy (ESWL) among the treated male (A) and control male (B) groups.

Blood pressure (BP) changes	Group A (Treated males) n=25	Group B (Control males) n=25	P. value
Systolic BP. (Pre ESWL)	132 ± 10	132 ± 7	0.99
Systolic BP. (Immediately after ESWL)	137 ± 8	132 ± 8	0.03
Systolic BP. (3rd month after ESWL)	138 ± 9	133 ± 13	0.01
Diastolic BP. (Pre ESWL)	73 ± 6	74 ± 5	0.52
Diastolic BP. (Immediately after ESWL)	87 ± 8	74 ± 5	<0.00001
Diastolic BP. (3rd month after ESWL)	84 ± 7	75 ± 10	0.0006

*p. value <0.005 was statistically significant

Table No.2: Correlation of systolic & diastolic blood pressure before, immediately after and on 3rd month post extra corporeal shock wave lithotripsy (ESWL) among the treated female (C) and control female (D) groups.

Blood pressure (BP) changes	Group C (Treated females) n=25	Group D (Control Females) n=25	P. value
Systolic BP. (Pre ESWL)	133 ± 8	135 ± 6	0.322
Systolic BP. (Immediately after ESWL)	139 ± 8	133 ± 8	0.01
Systolic BP. (3rd month after ESWL)	138 ± 8	132 ± 9	0.01
Diastolic BP (Pre ESWL)	73 ± 6	73 ± 5	0.99
Diastolic BP. (Immediately after ESWL)	85 ± 7	76 ± 5	<0.001
Diastolic BP. (3rd month after ESWL)	84 ± 8	76 ± 10	0.003

*p.value <0.005 was statistically significant

DISCUSSION

Despite it's clinically and radiologicaly successful results, ESWL is not free from complications in term of morphology and physiology[14,15,16]. Magnetic resonance imaging proved to be highly sensitive in detecting renal alterations after ESWL. Up to 63% of all kidneys treated with ESWL showed pathological changes in the kidney[17]. The over all frequency of hypertension (HTN) requiring treatment in our community (Lahore, Pakistan) was 12 % in males and 8% in females. This frequency is relatively higher and alarming in our male community as compared to female community which is in relatively close agreement with the report of Williams and Kaude who found that (8%) of patients required pharmacological intervention for HTN[5]. This higher incidence of HTN (12%) in male as compared to females can be probably due to stress oriented community atmosphere. Beyond the age of about 45 years (in both men and women) systolic BP rises at an average rate of 0.5-1.0 mmHg/year until 7th decade[19]. All the patients with sustained HTN listed in this report developed HTN either immediately after ESWL or within 3 months after ESWL, thus exceeding any age related increase in BP.

Peterson and Finlayson suggested that renal trauma caused by ESWL may cause HTN as the result of perirenal hematoma via the well known page kidney effect (Trauma → perirenal hemorrhage → fibrosis → compression of renal parenchyma → ↑ interstitial pressure → ↓ renal perfusion → ↑ rennin release → ↑ generation of Angiotensin II → HTN)[20].

CONCLUSION

In conclusion, extracorporeal shock wave lithotripsy (ESWL) creates a higher risk for the development of HTN in males (12%) as compared to females (8%).

The observation in this report together with those of Lingeman and Kulb strongly support the need for such a prospective study[21]. Because hypertension induced renal trauma may be delayed and is often asymptomatic. Urologists and other physicians performing ESWL should be alerted to the fact that HTN is a potentially important complication of the procedure. Our experience shows that blood pressure should be measured periodically for at least 1 year after ESWL..

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