

Prevalence of diabetes mellitus after extra corporeal shock wave lithotripsy in 15 years follow-up

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Abstract

Objective: To investigate the hypothesis that extracorporeal shock wave lithotripsy (ESWL) increases the risk of new onset diabetes mellitus (DM) or significant changes in fasting blood sugar (FBS).

Materials and Methods: A total number of 307 patients enrolled in this study. All of them had undergone ESWL for kidney stone from 1991 to 1994. In 2009, after 15-19 years, we invited patients to check their blood sugar.

Results: There were 307 patients, 19.8% females, and 80.1% males. The mean age of the patients was 44 for females and 42 years for males. 47.5% had kidney stone in the left side, 42.9% in the right side and 9.4% bilateral. The mean FBS increasing was 11.86 g/dl. It was 14.54 g/dl for the right side, 8.57 g/dl for left and 16.24 g/dl for bilateral ESWL.

Discussions: The increasing of FBS is more significant in shock wave intensities higher than 15.5 KV. And there wasn't any significant relationship between age, sex, body mass index (BMI) and total number of shock waves with increasing of FBS. ESWL treatment might associate with increasing FBS without any relation to age, sex and BMI.

Keywords: Diabetes mellitus, extracorporeal shock wave lithotripsy, fasting blood sugar

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INTRODUCTION

Since 1982, extracorporeal shock wave lithotripsy (ESWL) changed dramatically management of stones but with its popularity new concerns have developed about the potential adverse effects associated with ESWL.^[1] In a retrospective study, Krambeck proposed that diabetes mellitus (DM) was a potential complication of ESWL related to number and

intensity of shock waves.^[2] In another research Makhlof concluded that patients treated with ESWL don't develop DM at greater rate than does the general population at 6 years of follow-up.^[3] According to the above finding the aim of this study was to investigate the prevalence of DM or significantly increasing fasting blood sugar (FBS) after 15 years of ESWL for managing urolithiasis.

MATERIALS AND METHODS

It was a cohort study of 307 patients who underwent ESWL at the hospital, since 1991 until 1994 for kidney stones by the Storz lithotripter (Lithostar- SIEMENS- 1990). An invitation was sent to 1400 consecutive patients. 307 patients accepted our invitation and came back to ESWL department. We reviewed the documents of them at the time of ESWL, with specific notification to their medical history including D.M,

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hypertension and cardiac disorders and BMI. Their CBC, FBS, UREA, Cr, PT, PTT, U.A and U.C were checked. Stone burden, side and stone location, total number and intensity of shockwaves and amount of x-ray exposure were written. The patients' current height and weight, BMI and their FBS checked, and asked about history of DM, and date of onset or diagnosis of DM, family history of DM, and current medications. The operative records were reviewed to obtain data on stone burden, number of shockwaves, and laterality of treatment. Exclusion criteria for this study were previous history of DM. A statistical analysis was done with the version 17 SPSS statistical package. This study had been approved by Ethical committee of university.

RESULTS

The total number of 307 patients who have undergone ESWL for kidney and upper ureteral stone were selected. There were 61 (19.8%) female patients and 246 (80.13%) male patients. The mean age was 43.61 years (11-70) for females and 41.63 years (7-72) for males. There were 132 (42.99%) patients with right side, 146 (47.55%) with left side and 29 (9.44%) with bilateral kidney stone. The mean stone size was 2.03 cm. The number of shockwaves was 1000-50000 (divided in multiple sessions) and its intensity was 14-20 KV. The average increment of FBS was 11.86 g/dl. It was 16.24 g/dl in bilateral, 14.54 g/dl in right side and 8.57 g/dl in left side ESWL. The increasing of FBS (FBS f_P = FBS follow up-FBS patient) was more significant in ESWL with intensities higher than 15.5 KV [Figure 1]. The prevalence of DM according to ADA (American Diabetes Association) criteria's for diagnosis of DM was about 8.1% after ESWL. There were no any correlations between age [Figure 2] and BMI [BMI = wt (kg)/ht (m²)] with increasing of FBS. There were no any correlations between total number of shock waves [Figure 3] and increasing of FBS.

DISCUSSION

The potential use of ESWL as a new modality for management of urolithiasis was proposed in 1960 by Dornier. In 1980, it was used for the first time and the first successful clinical series using this modality reported in 1982.^[1]

Nowadays, ESWL is a safe and non-invasive procedure. More than 90% of stones in adults might be suitable for ESWL treatment. A majority of solitary kidney stones are less than 10 mm. Thus, they can treat successfully by ESWL. For stones between 10 and 20 mm, often ESWL is the first choice, because this modality is considered noninvasive and effective. Algorithm I shows an applicable way for management of renal stones (Algorithm I).^[4]

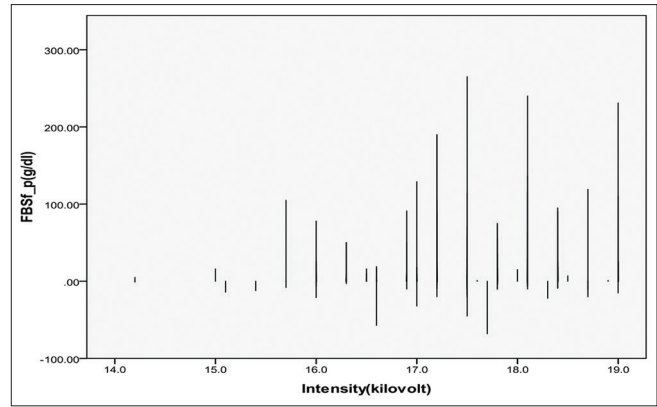


Figure 1: Correlation between intensity of shockwaves and increment of FBS

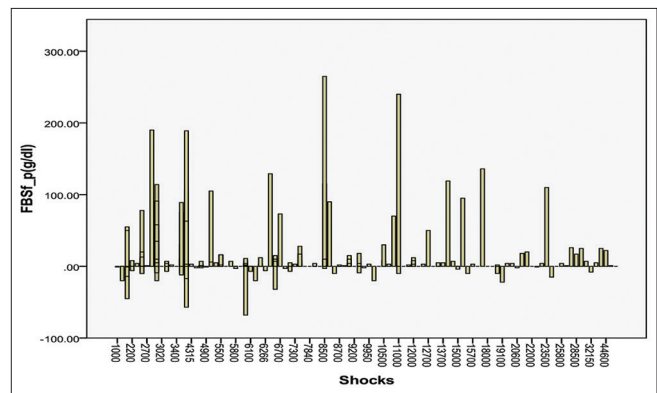


Figure 2: Correlation between age and increment of FBS

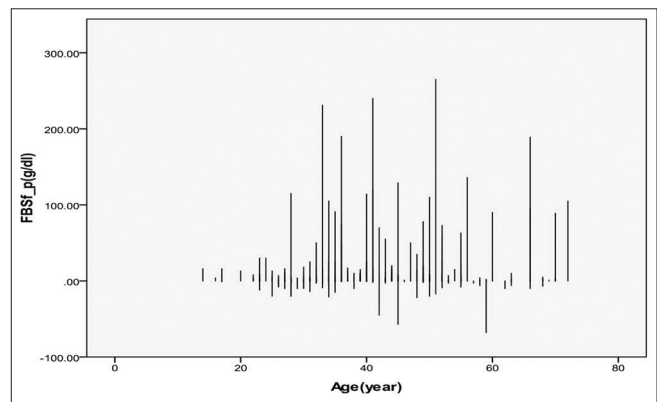
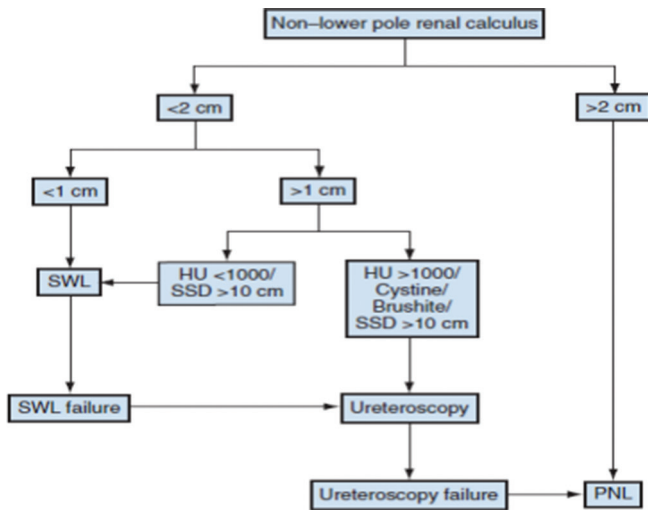


Figure 3: Correlation between total number of shockwaves and increment of FB

In children, ESWL is a safe and effective method for treating renal and upper ureteral stones.^[5]

There are many negative factors that affect on outcome of ESWL, some of them are related to stone (size > 20 mm), certain compositions like cystine, calcium oxalate monohydrate, brushite and Hounsfield more than 1000 or related to kidney (obstruction, stone in lower pole) and related to patient (obesity, body habits).^[6] There are several



Algorithm 1: Treatment algorithm of kidney stones. HU: Hounsfield unit, PNL: Percutaneous nephrolithotomy, SWL = Shockwave lithotripsy, SSD = Stone-to-skin distance. (Adopted from Wen CC, Nakada SI. Treatment selection and outcomes: Renal calculi. *Urol Clin North Am* 2007;34:409-19)

contraindications for using of ESWL including: pregnancy, bleeding diathesis,^[7] uncontrolled urinary tract infections, skeletal malformations, severe obesity, arterial aneurysm^[8] and obstruction distal to stone.

The possible complications of the ESWL can be related to Stone fragments: Steinstrass, re-growth of residual fragments, renal colic, infectious: bactriuria in non-infection stones, sepsis or to tissue effect: renal hematoma,^[9] symptomatic and asymptomatic,^[10] cardiovascular dysrhythmia, morbid cardiac events, gastrointestinal bowel perforation^[11] liver, spleen hematoma and spinal cord epidural hematoma.^[12] There are many unusual complications after ESWL; hypertension,^[13,14] that maybe is a sequel of perinephric hematoma (page kidney). Another complication is DM.

The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030.^[15] In our study according to ADA (American Diabetes Association) criterion for diagnosis of DM the prevalence of DM was about 8.1% after ESWL [Table I].

In a study by Krambeck AE and co-workers, at 19 years of follow up ESWL for kidney and upper ureteral stones was associated with a slightly higher likelihood of occurring hypertension and diabetes than other patients who underwent other therapies for kidney stone. In that study, 630 patients who were treated with ESWL 19 years prior, compared with a control group who treated conservatively for kidney stones at the same time. They found that in the first group (ESWL) hypertension and DM are higher than the control group. Their explanation was injury of islet cells of pancreas due to

Table 1: ADA recommendations for diagnosing diabetes

Diabetes symptoms (polyuria, polydipsia, polyphagia, increased fatigue, weight loss, blurred vision, growth impairment) exist and casual plasma glucose ≥ 200 mg/dl (11.1 mmol/l)
¹Note: Casual is defined as any time of day without regard to time since last meal; OR
²FPG >126 mg/dl (7.0 mmol/l); OR
³Plasma glucose ≥ 200 mg/dl (11.1 mmol/l) during an OGTT

If any of these test results occur, testing should be repeated on a different day to confirm the diagnosis, ¹Random is defined as without regard to time since the last meal, ²Fasting is defined as no caloric intake for at least 8 h, ³The test should be performed using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water; not recommended for routine clinical use. (Adopted from American Diabetes Association, 2007), ADA: American diabetes association

shockwaves.^[2] After that, a comparison of 772 patients treated with SWL for renal stones to 505 patients treated with SWL for ureteral stones by Sato showed no significant difference in the new onset of DM, suggesting that, SWL treatment for renal stones might not be associated with new-onset DM.^[16]

In recent investigation by Cógáin and coworkers in 2012, they didn't find any correlation between ESWL and D.M.^[17]

Makhlouf and co-worker, after a 6 years follow-up study, examined a cohort of almost 2000 patients who treated by ESWL between 1999 and 2002. They had a control group consisted of matched persons. They concluded that patients treated with ESWL; don't develop D.M greater than the control group.^[3]

Based on these studies, the correlation between ESWL and the development of diabetes mellitus is unknown.

We have some facts about these investigations:

1. In older studies, ESWL have done by older versions of shock waves systems with wider focal area than new systems
2. In first study of Krambeck, follow-up is done for 19 years,^[2] but in newest studies, follow-up period is shorter.^[3,16] New onset diabetes after ESWL may need long time after procedure.

In our study, we have a shock wave system that has made in 1990, and we followed patients for about 15 years and average increment of FBS is 11.86 g/dl. These rises of FBS are 14.54 g/dl for right side, 8.57 for left side and 16.24 for bilateral ESWL. We use the ADA (American Diabetes Association) criteria for diagnosis of DM.^[18] According these criteria the prevalence of DM is found in 8.15% of patients. This is more than the prevalence of DM in our region.^[19]

There are not any correlation between FBS rising and age, sex and BMI. We couldn't find any regular relationship between total numbers of shock waves and FBS rising. But there is a

strong relation between FBS rising and intensities of shock waves, especially in intensities above 15.5 KV.

According to findings of the first study of Krambeck and our study, that in both, the older versions of shock wave system are used, this hypothesis is formed that Old versions (generations) of shock wave systems because of their wide focal area can damage other organs like pancreas.^[20]

Insulin is produced by the beta cells of pancreatic islets.^[21] Majority of these cells are located in head of pancreas, which is nearby the right kidney. There are three important facts in our study:

1. Our shock wave system is from old generation (Lithostar-1990)
2. Prevalence of new onset DM is highest in bilateral ESWL, follows by right side and least in left side ESWL. In bilateral procedure, damage to beta cells is extensive, in right side ESWL head of pancreas (main location of beta cells) is damaged and in left side, tail of pancreas is hurt
3. The main damaging factor in our study is intensity of shock waves, especially above than 15.5 KV.

As conclusion in a 15 year follow-up of ESWL for kidney and upper ureteral stones, the prevalence of the new onset of DM is raised about 8.15%. FBS increment is highest in bilateral ESWL, following by right side and left side ESWL. Another important finding is direct affect of intensity of shock waves on rise of FBS, especially intensities above 15.5 KV.

According to these findings, we have some recommendations for managing of kidney and upper ureteral stones by ESWL:

1. Shock waves with intensity less than 15.5 KV, is relatively safe. Use high total number-weak intensity shock waves
2. Using of shock wave systems with small focal area is reasonable
3. There are higher risks for occurring DM in bilateral and right side ESWL, in these cases, fine adjustment of focal point of system on stone is necessary.

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