

Impact of Nursing Protocol on Stone Clearance Rate and Acute Complications Following Extracorporeal Shock Wave Lithotripsy

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Abstract: For over 35 years shock wave lithotripsy considered as minimally invasive line of treatment for patients with urolithiasis, successful outcomes and risk of complications depending on several aspects including patient's educations and proper preparation of the patients. Nursing preparation of the patients including detailed health information's about the plan of treatment can impact the success of the procedure. **Objectives:** this study aims to determine the impact of nursing protocol on stone clearance rate and acute complications following shock wave lithotripsy in patients with renal and ureteric calculi. **Setting:** Shock Wave Lithotripsy Unit, Urology Department of Alexandria Main University Hospital, Alexandria, Egypt. **Subjects:** Data was collected from 60 patients with renal and ureteric calculi treated for the first time with shock wave lithotripsy. A socio demographic, clinical characteristics structured questionnaire, were developed by the researcher and used for data collection. Each patient was interviewed individually for about 30 minutes after brief explanation of the study objective and assuring information confidentiality. **Results:** stone clearance rate were significantly improved after implementation of the nursing protocol and influence decreased side effects rate. As well as; lowered exposure rate for acute complications following shock wave lithotripsy in patients with renal and ureteric calculi. **Conclusion:** Medical health knowledge and nursing information significantly affect patients' outcomes and rate of treatment success. **Recommendation:** Nursing preparation and education in shock wave lithotripsy unit is necessary to provide patients with necessary oral and written information regarding their health conditions.

Keywords: stone clearance rate, shock wave lithotripsy, urolithiasis.

1. INTRODUCTION

Nephrolithiasis is one of the common clinical disorders with high prevalence occurring in approximately 10 % of the human population with an average recurrence rate of 25 %.⁽¹⁾, it considered the third most common disease of the urinary tract worldwide. In the last two decades the treatment of renal calculus disease has changed dramatically from open pyelolithotomy and ureterolithotomy to predominantly non-invasive procedures such as Extracorporeal Shockwave Lithotripsy (ESWL). Since the introduction of ESWL at 1980s, it has been considered as the cornerstone of treatment plan of more than 90% of urolithiasis due to its safety, simplicity, non-invasive characteristic, low complication rate, and allowing same day hospital discharge^(2,3,4).

Naturally, like any other treatment, its efficacy is indeed accompanied by some side effects and complications, despite being generally mild in nature, require accurate evaluation and implementation of measures to prevent them. Complications after an ESWL come from formation and passage of fragments, infections, effects of shock wave on renal and non-renal tissues including kidney function impairment and hypertension^(5,6). Each of these complications can be prevented adopting appropriate measures, such as the respect of the contraindications and the recognition and the correction of concomitant diseases or infection, and using the ESWL in the most efficient and safe way^(7,8).

Outcomes of ESWL and Stone Free Rates (SFR) may differ from one patient to another and it depends on many factors such as calculi size, location, composition, patient habits and life style, and the efficacy of the lithotripter as well. Each of these factors has an important influence on the re-treatment rate and final outcome. Nursing care plan of those patients should be tailored for each one individually to minimize complications and enhance stone free rate^(3,9).

Final outcome may be defined as treatment success or treatment failure, treatment success includes free of calculi, or calculi fragments less than 4mm, while no fragmentation, or calculi fragments larger than 4mm, in addition to the development of post ESWL complications are indicators of treatment failure⁽¹⁾. Other studies^(10,11) define complete success as complete cleaning of the urinary system or the remaining 4 mm stone or less and the presence of a stone larger than 4 mm and smaller than the original stone was considered as a partial success and failure to break the stone as a failure. Stone-free status was defined as the absence of stone on radiographic imaging, and retreatment was defined as further surgical intervention for residual stone fragments 0.5 cm.

One of the undesired side effects of ESWL is pain. Sometimes, severity of the flank pain during session of the treatment induces the patient to ask for the interruption of the treatment. The protocol of the procedure should include an analgesic prophylaxis, nursing assessment, planning, implementation and evaluations of measures to manage pain throughout the treatment session. Furthermore nursing intervention is very important to be applied in accordance with ESWL protocol to enhance patients out come and stone clearance rate, minimize side effects and complications. Nursing education should be started from decision of treatment until follow up to decrease rate of stone recurrence through obtain stone fragments for analysis of composition. This information will help guide dietary and medication recommendations and may alter decision making if future treatments are required. Repeat stone analyses can be helpful as composition can change over time, potentially due to ESWL treatment⁽¹²⁾.

Patient preparations for procedure, instructions and precautions to be followed throughout the procedure and discharge plan to prevent recurrence of the stones, all of that should be planed individually to meet every patient needs and diagnosis. Nursing management and education in ESWL unit is very important. Several studies indicated that patient's knowledge about urolithiasis disease and ESWL procedure was inadequate and there is a need for further studies about it^(3, 12). Therefore this study aims to determine the impact of nursing protocol on stone clearance rate and acute complications following shock wave lithotripsy in patients with renal and ureteric calculi.

2. MATERIALS AND METHOD

MATERIALS

Research hypotheses:

- 1- Patient with renal and ureteric stone following ESWL who received nursing protocol exhibit higher stone clearance than those who don't received.
- 2- Patient with renal and ureteric stone following ESWL who received nursing protocol exhibit lower acute complications than those who don't received.

Aim of the study: This study aims to evaluate the impact of nursing protocol on stone clearance rate and acute complications following extracorporeal shock wave lithotripsy in patients with renal and ureteric calculi.

Design: Quasi-experimental research design was used for the purpose of study.

Settings: This study was conducted at Shock Wave Lithotripsy Unit, Urology Department of Alexandria Main University Hospital, Alexandria, Egypt.

Subjects: The study comprised a convenience sample of 60 patients assigned randomly into two equal groups, group I: control group, was managed according to ESWL unit usual routine, group II: Study group, was subjected to nursing protocol and routine care of ESWL unit (30 patients for each one), diagnosed with renal and ureteric calculi treated with ESWL, attending the pre-mentioned health setting and meeting the following inclusion criteria:

- Adult (age 20- 60 years old)
- Normal renal anatomy.

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- Extracorporeal shock wave lithotripsy will be performed for the first time.

The exclusion criteria include:

- Patients with bilateral or multiple stones.
- Acute urinary tract infection.
- Uncontrolled coagulopathy.
- Uncontrolled hypertension.

Tools: based on an extensive review of related literature; three tools were used for the purpose of data collection.

Tool I: Socio demographic and clinical characteristics structured questionnaire: A structured interview were developed by the researcher^(3,9) to collect data pertinent to the study. It was composed of two sections: The first section included personal data such as age, gender, level of education, occupation, marital status...etc. While, the second section included medical data such as height, weight, BMI, vital signs, current diagnosis, past medical history...etc.

Tool II: Modified Numeric Pain Rating Scale (NRS-11)^(13,14): It is patient self-reporting of pain adopted by the researcher to assess pain severity with the following rating system: (0) no pain, (1-3) mild pain, (4-6) moderate pain, (7-9) severe pain, (10) worst pain. In addition to pain site; onset; duration; radiation, alleviating and aggravating factors.

Tool III: Extracorporeal Shock Wave Lithotripsy Predictors of Outcomes Assessment Tool (ESWL-POA): This tool was developed by the researcher⁽¹⁵⁻¹⁷⁾ It composed of two sections: The first section included data pertinent to predictors of outcomes such as calculi side, number of calculus, calculi site, type of calculi, calculi size,...etc. While, the second section included data pertinent to side effects such as nausea, vomiting, diarrhea, hematuria, bruises...etc; complications and final treatment result as well; it is completed after the second and third session.

ESWL nursing protocol content:

- ESWL description and definition
- Indications and contra indications
- Patient preparations for procedure
- Instructions and precautions to be followed during cession
- Instructions and precautions to be followed after cession
- Side effects minimizing
- Acute complication prevention and management
- Long term plan to prevent recurrence of the stones and follow prescribed medications.

Every patient was interviewed individually during the first cession of ESWL to collect the necessary data before starting session to complete tool one, Measuring vital signs, body weight, height and calculate body mass index, Immediately after first session the two remaining tools was completed for both groups, among the study group give the patient all information and explanation needed for started the treatment plan. Give the patient time for asking questions and answer patients' questions about procedure and inform the patient about preparation for the second session. The second nursing assessment was done immediately after the second and third cession and giving all needed information and gives the patients time for asking any questions. Patients selected for control group was take the routine ESWL unit information and preparations.

Method

Ethical considerations: oral permission to conduct our study was obtained from every patient after explanation of the aim of the study. Privacy and anonymity was maintained for all participants. Confidentiality of the collected data assured. Participation in the research was voluntary. Right to withdrawn from the study confirmed.

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Tools: All tools were developed by the researcher after extensive review of relevant literatures^(3, 9, 13-17). Content and construct validity of the tools were ascertained by a jury of 5 experts in the fields of medical surgical nursing. Necessary modifications were done accordingly. Internal consistency was used in ascertaining reliability of tool II (0.715) and of tool III (0.861) using Cronbach Alpha Coefficient Test.

Pilot study: Tools were pre-tested on 10 patients who were not included in the study sample. After analyzing the data obtained from the pilot study, some modifications were introduced accordingly.

Data collection: Every patient was interviewed individually for an average period of 30 minutes after brief explanation of the aim of the study. Data was collected over a period of 4 months starting from January to end of April 2018.

Development of nursing protocol:

This was developed by the researcher after thorough review of literature. The patient interviewed three times during the first three session of ESWL using three tools of the study. The duration of each session was approximately from 30 -40 minutes.

The study was carried out through four phases:**1. Assessment phase:**

- Collect all data base line about bio-sociodemographic characteristics of the studied patients using tool I and measuring vital signs.
- Measuring body weight, height and calculate body mass index.
- Study group was given all information and explanation mention before in protocol content for started the treatment plan.
- After session complete the nursing assessment using tool II and III.

2. Planning phase:

- For the study group patients, based on the data collected from the assessment phase and literature review, the nursing protocol goals, priorities, content and expected outcomes were developed by the researcher according to patient's individual needs and problems.

3. Implementation phase:

- The advanced nursing protocol for study group was conducted and applied individually for each patient.

4. Goals and expected outcomes of nursing protocol:

- Achieve lower acute complications.
- Achieve higher stone clearance rate.

Statistical analysis: After data collection, they were coded, transferred into a specially designed format to be suitable for computer feeding, then entered, checked, and verified to avoid any error during data entry. Statistical analysis was performed using Statistical package for Social Sciences (SPSS version 20). The level of significance selected for this study was p equal to or less than 0.05.

The used tests were

1 - Chi-square Test: for categorical variables, to compare between different groups

2 – Fisher's Exact Test: correction for chi-square when more than 20% of the cells have expected count less than 5.

3. RESULTS

Table (1) more than one third of the patient's age were ranged between (40-49) years old, distributed as (30%) in the control group and (56.7%) in the study group. More than two third of studied subjects were males and married with a percentages of (68.3%) and (53.3%), respectively. (40%) of the control group was illiterate while (30%) of the study

group was secondary educated. Respiratory diseases were the most prevailing diseases reported by both groups (40% and 53.3) respectively for control and study group. Gout and liver diseases were reported by (23.4% and 13.) respectively among control group while, had a history of while; hyperparathyroidism and cardiovascular diseases represent (13.3% and 10.0%) respectively among study group.

Table (2) it was noticed from the table that (40%) of control group diagnosed with stone at middle calyx of the kidney and (46.7%) among study group diagnosed with stone at the same sit. Concerning stone site more than half of the patients suffered from stone at the right site. All patients among both groups have single stone. In relation to calculi size more than half of the studied patients among control and study group had low diameter stone size (56.7% and 53.3%), respectively.

Table (3) in relation to pain severity the differences was highly statistically significant within both groups and between the two groups in the three follow up period ($p=0.000$) ($p=0.000$) ($p=0.000$) respectively.

Table (4) illustrated comparison between study and control group in relation to acute complications. Results revealed that there is no statistically significant differences in relation to all items of acute complications within the group and between the two group pre and post application of nursing protocol except urinary tract infection and steinstrasse there were significant deference within the study group only ($p=0.009$, 0.009) respectively.

Table (5) showed that comparison between control and study group regarding treatment outcomes. The difference was not statistically significant within both group and between the two group post nursing protocol application except in relation to the third session ($p= 0.004$).

4. DISCUSSION

To achieve treatment success among patients with urinary stones, patient must be fully informed with all health information needed about the medical condition, different available line of treatment and potential complications risk for each one. So, nurses and health care providers must be familiar with patient`s priorities and expectations and tailoring intervention for each patient to reach high level of patient`s satisfaction with treatment success and minimize risk of complications. This study aims to evaluate the impact of nursing protocol on stone clearance rate and acute complications following extracorporeal shock wave lithotripsy in patients with renal and ureteric calculi.

The present study revealed that nursing preparation and health education of patients undergoing ESWL is one of ESWL unit nursing responsibilities that maximizing treatment success and minimizing complications. Findings of the current study showed that the mean of age for the study and control group was (46.57 ± 6.97 and 44.22 ± 7.519) respectively, this was supported by Hoseinkhani A et al. (2018)⁽¹⁸⁾ and Lucio J et al. (2011)⁽¹⁹⁾ who founded in their studies that that mean of age was (43.6 ± 7.1) year.

As regards sex, the present results revealed that the majority of the studied patients among both groups were male patients. This was similar to findings of the **Hoseinkhani et al. (2018)**⁽¹⁸⁾ and **Ghalayini F et al. (2006)**⁽²⁰⁾ who founded in their studies that male patients undergoing ESWL procedure represented the highest percentage than females. It can be explained by that difference in anatomical structure between males and females; in which male urethra is longer than female, this may cause accumulation and stagnation of urine in the bladder for longer times. Also increased incidence in males has been attributed to increased dietary protein intake, which increases urinary excretion of phosphates and magnesium and reduces urinary citrate concentration. While the lower risk of stone formation in women was attributed to estrogen treatment in postmenopausal women that can decrease the risk of stone recurrence by lowering urinary calcium and calcium oxalate saturation. Estrogen may also help to prevent the formation of calcium stones by keeping urine alkaline and raising protective citrate levels.

Concerning the educational level, it was observed that illiteracy had the highest percentage in studied patients represented. This was in consistent with findings of **Mohammed et al. (2015)**⁽¹²⁾. Who founded in their study that approximately half of the studied patients were illiterate. The present findings could be attributed to the setting of the study which is a free university governmental hospital that serve not only urban but also many rural areas and the majority of patients had low educational and economic standard.

Also results revealed that the vast majority of the studied patients among control and study group were living in rural areas. This results supported by findings of Sundaram et al. (2012) ⁽²¹⁾, who founded that urinary calculi incidence lowered among population in industrialised countries which affects about 5–15% of the study sample. While disagree with Onkar et al. (2009) ⁽²²⁾ who mentioned that place of residence had no effect on incidence of urinary tract stones or outcomes of ESWL.

This study showed that majority of the patients had chronic diseases, with highest percentage for respiratory diseases, gout, Hyperparathyroidism and liver diseases. This was highly agreeing with results of several studies ⁽²³⁻²⁵⁾ revealed increased stone formation in hypertensive and diabetic patients.

Concerning pain assessment of study and control group the results revealed that; pain was experienced after session among large percentage in both groups of the study. Results revealed that more than half of the patients among both groups reported flank pain started gradually at right side. More than half of the studied patients among control group experienced pain lasting for less than 15 minutes after three session of treatment. These results go with the same line with Vergnolles et al (2009) ⁽²⁶⁾ who stated that ESWL is a noninvasive but painful procedure. Other study done by Gul wazir et al (2010) ⁽²⁷⁾ state hat flank pain was the commonest complication, which was 9.76%; it was treated by prescribing NSAIDs. It is logic for stone clearance to be the top priority for all patients. In spite of being a very important clinical issue, pain-free treatment did not represent a foremost priority for patients undergoing ESWL. This can be explained that patients might accept some pain to reach their ultimate goal of being stone free. On the other hand, the issues related to understanding the condition, procedure and x-rays play a leading role in patients' priorities. This emphasizes the importance of health education prior to ESWL Abdelmowla et al (2018) ⁽²⁸⁾.

Concerning comparison of stone clearance after session three between the two groups, results revealed that success free rate of stones by ESWL occurred in the study group more than the control group presented by percentages of. The outcome of ESWL was described as; a success or failure, whereas success means stone-free (complete stone clearance, or clinically insignificant residual fragments <4 mm). While failure means residual stone fragments (clinically significant residual fragments more than 4 mm after three sessions of ESWL, as confirmed by a plain film). Hence findings reflected statistical significant different between success free rate of stones by ESWL in both groups, in which stone clearance rates occurred in the study group more than the control group. These findings were highly in approval with findings of Sulieman et al (2010) ⁽²⁹⁾ who stated that ESWL, which was first conducted in Germany during 1980, is noninvasive treatment of renal stone disintegration by shock waves, with a high success rate. It can be explained by patients in governmental hospital had no chance to receive medical advice and health education accordingly; patients may exhibit deficient in health information needed for peter management.

5. CONCLUSION

The present study concluded that, ESWL provides an excellent, safe, minimally invasive option for treatment of patients suffering from renal and ureteric stone with low risk of complications. ESWL considered as a minimally invasive day procedure with fast recovery time can be performed under sedation without ureteric stenting. Appropriate patient selection and patient preparation for the procedure with necessary medical information can better prognosticate of treatment success and prevent post ESWL complications and improve patient's outcomes.

6. RECOMMENDATIONS

- Initial assessment and appropriate selection of patients for ESWL reduce the risk of treatment failure and lower risk for complications.
- Preparation of the patient should be routinely done immediately after selection for treatment and considered as a part of nursing intervention within the ESWL unit.
- Nurses should be taught about the importance of patient preparation and patient educations to reduce morbidity and mortality.

Table (1) Distribution of patients undergoing ESWL among control and study group according to their socio-demographic characteristics.

Socio-demographic characteristics	(no= 60)				Total		Significance test
	Control Group		Study Group		No= 60	%	
	No= 30	%	No= 30	%			
Age (years)							
20 –9	5	16.7	1	3.3	6	10.0	$\chi^2 = 13.962$ P = 0.002*
30 –9	10	33.3	1	3.3	11	18.4	
40 –9	9	30.0	17	56.7	26	43.3	
50-60	6	20.0	11	36.7	17	28.3	
X ± SD	46.57 ± 6.97		44.22 ± 7.519				
Sex							
Male	21	70.0	20	66.7	19	31.7	$\chi^2 = 0.077$ P = 0.781
Female	9	30.0	10	33.3	41	68.3	
Level of education							
Illiterate	12	40.0	5	16.6	17	28.3	FET = 17.824 P = 0.001*
Read& write	6	20.0	0	0.0	6	10.0	
Primary +Preparatory	0	0.0	8	26.7	8	13.3	
Secondary	7	23.3	9	30.0	16	26.7	
Higher education	5	16.7	8	26.7	13	21.7	
Marital status							
Single	13	43.3	3	10.0	16	26.7	FET = 11.892 P = 0.007*
Married	15	50.0	17	56.7	32	53.3	
Divorced	2	6.7	9	30.0	11	18.3	
Widow	0	0.0	1	3.3	1	1.7	
Residence							
Urban	9	30.0	19	63.3	28	46.7	$\chi^2 = 6.696$ P = 0.009*
Rural	21	70.0	11	36.7	32	53.3	
Occupation							
Not working	6	20.0	4	13.3	10	16.6	FET = 4.064 P = 0.254
Clerical work	8	26.7	3	10.0	11	18.3	
Manual work	10	33.3	13	43.3	23	38.3	
House wife	6	20.0	10	33.3	16	26.7	
Respiratory diseases	12	40.0	16	53.3	14	23.3	
Cardiovascular diseases	1	3.3	3	10.0	4	6.7	
Gout	7	23.4	2	6.7	23	38.3	
Osteoporosis	1	3.3	0	0.0	1	1.7	
Hyperparathyroidism	0	0.0	4	13.3	4	6.7	
Liver disease	4	13.3	0	0.0	4	6.7	
Diabetes mellitus	3	10.0	2	6.7	22	36.33	

* No= Number FET= Fisher's exact test

*Significant difference at P level ≤ 0.05

Table (2): Distribution of patients among both control and study groups according to present stone characteristics.

Present stone characteristics	(no= 60)				Total		Significance test
	Control Group		Study Group				
	No= 30	%	No= 30	%	No= 60	%	
Site of stones							FET = 9.538 P = 0.049*
Upper calyx	1	3.3	0	0.0	1	1.6	
Middle calyx	12	40.0	14	46.7	26	43.3	
Lower calyx	10	33.3	16	53.3	26	43.3	
Upper ureter	3	10.0	0	0.0	3	5.0	
Mid ureter	4	13.3	0	0.0	4	6.7	
Distal ureter	0	0.0	0	0.0	0	0.0	
Stone side:							FET = 0.271 P = 0.602
Right	18	60.0	16	53.3	34	56.7	
Left	12	40.0	14	46.7	26	43.3	
Both	0	0.0	0	0.0	0	0.0	
Number of stone							FET = - P = -
Single	30	100	30	100	60	100	
Multiple	0	0.0	0	0.0	0	0.0	
Stone size							FET = 0.412 P = 0.813
Low diameter	17	56.7	16	53.3	33	55.0	
Medium diameter	10	33.3	12	40.0	22	36.7	
High diameter	3	10.0	2	6.7	5	8.3	

* No= Number FET= Fisher's exact test

*Significant difference at P level ≤ 0.05

Table (3): Comparison between control and study group patients following ESWL regarding pain severity pre, post one session, two sessions and three sessions of nursing protocol.

Sessions	Control group (N=30)										Study group (N=30)										Significance test			
	Pain severity										Pain severity										P1	P2	P3	P4
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%						
Pre nursing protocol	1	3.3	3	10.0	6	20.0	20	66.7	0	0.0	0	0.0	3	10.0	10	33.3	15	50.0	2	6.7	FET= 65.714 P= 0.000*	FET= 81.923 P= 0.000*	FET= 27.272 P= 0.000*	FET= 118.281 P= 0.00*
Post one session	1	3.3	7	23.3	13	43.3	9	30.0	0	0.0	0	0.0	21	70.0	5	16.7	4	13.3	0	0.0				
Post two sessions	3	10.0	15	50.0	10	33.3	2	6.7	0	0.0	8	26.7	15	50.0	7	23.3	0	0.0	0	0.0				
Post three sessions	8	26.7	18	60.0	4	13.3	0	0.0	0	0.0	19	63.3	10	33.3	1	3.3	0	0.0	0	0.0				
Significance test	FET=181.343 P = 0.000*										FET= 196.879 P = 0.000*													

* No= Number FET= Fisher's exact test

*Significant difference at P level ≤ 0.05

P1= p value comparing between both group patients pre nursing protocol application.

P2=p value comparing between both group patients on the 1st session post nursing protocol application.

P3= p value comparing between both group patients on the 2nd session post nursing protocol application.

P4= p value comparing between both group patients on the 3rd session post nursing protocol application.

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Table (4): Comparison between control and study group patients following ESWL regarding acute complications post one session, two sessions and three sessions of nursing protocol.

Acute complications	Control group (N=30)						Study group (N=30)						Significance test		
	Post 1 session		Post 2 sessions		Post 3 sessions		Post 1 session		Post 2 sessions		Post 3 sessions		P1	P2	P3
	No	%	No	%	No	%	No	%	No	%	No	%			
1- UTI • Yes • No	2 28	6.7 93.3	0 30	0.0 100	0 30	0.0 100	6 24	20.0 80.0	2 8	6.7 93.3	0 30	0.0 100	FET= 2.307 P= 0.128	FET= 2.068 P= 0.150	FET= - P= -
Significance test	FET= 2.068 P= 0.150						FET= 6.666 P= 0.009*								
2- Obstructive uropathy • Yes • No	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	FET= - P= -	FET= - P= -	FET= - P= -
Significance test	FET= - P= -						FET= - P= -								
3- Massive Hematuria • Yes • No	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	FET= - P= -	FET= - P= -	FET= - P= -
Significance test	FET= - P= -						FET= - P= -								
4- Dysrhythmia • Yes • No	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	FET= - P= -	FET= - P= -	FET= - P= -
Significance test	FET= - P= -						FET= - P= -								
5- Renal & pre-renal hematoma • Yes • No	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	FET= - P= -	FET= - P= -	FET= - P= -
Significance test	FET= - P= -						FET= - P= -								
6- Steinstrasse • Yes • No	5 25	16.7 83.3	2 8	6.7 93.3	2 8	6.7 93.3	4 26	13.3 86.7	2 8	6.7 93.3	0 30	0.0 100	FET= 0.130 P= 0.717	FET= - P= -	FET= 2.068 P= 0.150
Significance test	FET= 1.455 P= 0.227						FET= 6.666 P= 0.009*								
7- Anuria • Yes • No	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	0 30	0.0 100	FET= - P= -	FET= - P= -	FET= - P= -
Significance test	FET= - P= -						FET= - P= -								

Table (5): Comparison between control and study group patients following ESWL regarding treatment outcomes measurements post one session, two sessions and three sessions of nursing protocol.

FET= Fisher's exact test.

*Significant difference at P level ≤ 0.05.

Sessions	Control group (N=30)								Study group (N=30)								P1	P2	P3
	Treatment out comes measures								Treatment out comes measures										
	Treatment success				Treatment failure				Treatment success				Treatment failure						
	Calculi free		Fragments ≤ 4mm		Fragments ≥ 4mm and scheduled another session		No fragmentation and scheduled another session		Calculi free		Fragments ≤ 4mm		Fragments ≥ 4mm and scheduled another session		No fragmentation and scheduled another session				
No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%		
First session	15	50.0	11	36.7	3	10.0	1	3.3	17	56.7	11	36.7	2	6.7	0	0.0	FET=1.325 P= 0.723	FET=1.325 P= 0.723	FET=7.155 P= 0.004*
Second session	15	50.0	11	36.7	3	10.0	1	3.3	17	56.7	11	36.7	2	6.7	0	0.0			
Third session	16	53.3	13	43.3	0	0.0	1	3.3	24	80.0	5	16.7	1	3.3	0	0.0			
Significance test	FET= 3.198 P= 0.361								FET= 3.777 P= 0.151										

P1=p value comparing between both group patients on the 1st session post nursing protocol application.

P2= p value comparing between both group patients on the 2nd session post nursing protocol application.

P3= p value comparing between both group patients on the 3rd session post nursing protocol application

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