Analysis of clinical efficiency and application advantages of extracorporeal shock wave lithotripsy in the treatment of urinary calculi

Junbo Yao，Bo Jia，Siwen Ddeng

Department of Urology, Wuhan Dongxihu District People's Hospital, Hubei 430040, China

Introduction. To study and explore the clinical efficiency and application advantages of extracorporeal shock wave lithotripsy in the therapy of urinary stone.

Methods. The time range of sample collection was from January 2021 to October 2022. From the instances of urinary stone in the hospital at this stage, 1000 cases of sufferers with urinary stone receiving drug treatment and 1000 cases of patients with urinary stone receiving extracorporeal shock wave lithotripsy were regarded as the study samples, and they were set as the control group and the research group respectively. The clinical data of sufferers in the 2 groups were retrospectively analyzed. To compare the stone free rate, stone removal time, and the frequency of adverse reactions between the 2 groups. The serum inflammatory factor indicators, symptom scores, comfort scores, psychological scores, sleep status indicators, and life quality scores were compared between the 2 groups at pre-therapy and post-therapy. Results. To compare the stone free rate and stone removal time between the 2 groups, the stone free ratio in the study one was greater ($p<0.05$), and the stone removal time in the study one was shorter than that in the control one ($p<0.05$). There had no obvious distinction in the frequency of adverse reactions between the study one and the control one ($p>0.05$). After therapy, compared with the levels of pre-treatment serum inflammatory factor indicators CRP, PCT, TNF- α before the treatment, the measured values of the 2 groups were significantly decreased, while the values of the above indicators in the study one were less than the control one ($p<0.05$). After therapy, the points of renal colic, hematuria, dysuria and other symptoms of sufferers in the 2 groups were obviously less than before therapy, while compare to the control one, the points of various symptoms in the study one were lower ($P<0.05$). After treatment, compared with the scores of comfort and psychological assessment before

treatment, the scores of the 2 groups were significantly improved, while compared with the control one, the scores of comfort assessment in the study one were higher, and the points of the two psychological assessments in the study one were lower (P<0.05). After therapy, compare to the indicators of night sleep monitored in the control one, the data of sleep latency and actual sleep duration in the study group were better, and the point of sleep quality in the study one was lower, while the sleep related data monitored and evaluated at night in the 2 groups were all obviously improved than that at pre-therapy (P<0.05). After therapy, the points of all aspects of life quality of sufferers in the 2 groups were obviously greater than those at pre-therapy, and the points of quality of life in the research one were greater than the control one after comparison between the 2 groups (P<0.05).

Conclusion. After the onset of sufferers with urinary calculi, extracorporeal shock wave lithotripsy can achieve better stone removal effect than conventional drug treatment. It can discharge the stones more quickly, reduce the symptoms and inflammatory reactions of sufferers, decrease the physical discomfort of sufferers, and improve their psychological, sleep and life quality. And the application of extracorporeal shock wave lithotripsy does not increase the risk of adverse reactions, with good safety.

Keywords. urolithiasis; Drug treatment; Non operative treatment; Extracorporeal shock wave lithotripsy

INTRODUCTION

Urinary calculi are very common in clinic, mainly refers to the calculous lesions in the urinary system, especially ureteral calculi and kidney stones [1-3]. After the onset of urinary calculi, patients will have renal colic, hematuria, dysuria and other symptoms, which will seriously affect the daily life of patients. If the disease is not treated in time, the stones will gradually increase in size and number, and the pain of patients will increase, which will bring serious pain to patients, and the quality of life will be significantly reduced [4-6]. For urinary calculi, there are many methods for the clinical therapy of this disease. Because of the relatively serious trauma caused by open surgery, non-surgical treatment has been widely used in the therapy of urinary

calculi. The non-surgical therapy of urinary calculi is mainly based on drug therapy and physical therapy. Among them, drug therapy can promote the excretion of patients' stones through urine to a certain extent, but the stone clearance rate needs to be improved, especially for stones with relatively large diameter, which can not be discharged by drug therapy. In recent years, the application frequency of extracorporeal shock wave treatment, a physical therapy method, in the treatment of urinary calculi has increased. It mainly uses shock wave to break stones in vitro, so that stones can be discharged with urine. This stone treatment method usually has relatively high stone removal effect [7-9]. To explore the role of extracorporeal shock wave therapy in the therapy of urinary stone, from January 2021 to October 2022, 1000 sufferers with urinary stone who received drug therapy and 1000 sufferers with urinary stone received in extracorporeal shock wave lithotripsy in the hospital were selected in this study. A retrospective study was carried out in the 2 groups of sufferers, and the therapeutic effects of the 2 groups of patients after the implementation of the treatment scheme were compared.

1 DATA AND METHODS

1.1 General data

The time range of sample collection was from January 2021 to October 2022. From the cases of urinary calculi in the hospital at this stage, 1000 sufferers with urinary stone received in drugs and 1000 sufferers with urinary stone received in extracorporeal shock wave lithotripsy were regarded as the study samples, and they were set as the control one and the research one, respectively. The clinical data of sufferers in the two groups were retrospectively analyzed. There were 597 men and 403 women in control one, and the mean age was (39.45 ± 8.29) years, ranging between 18 and 63 years old. For the disease types, there were 621 instances of renal calculi and 379 instances of ureteral stone. And the average stone diameter was (8.03 ± 1.48) mm, ranging from 6 to 10 mm. It had 594 men and 406 women in the research one, aged between 18 and 64 years old, and the mean age was (39.72 ± 8.13) years

old. For the disease types, there were 616 instances of ureteral calculi and 384 instances of renal calculi. And the stone diameter ranged between 6 and 10 mm, and the mean diameter was (7.95 ± 1.52) mm. The gender, age, disease type and stone diameter in the general data were compared between the 2 groups. With the results of statistical analysis, it could be seen that $p>0.05$, which confirmed that the general data of the 2 groups were matched and the study was comparable.

Inclusion criteria: (1) The sufferers who were diagnosed with urinary stone by symptom observation and imaging examination; (2) Adults who aged between 18 and 65 years old; (3) The patients who were conscious at the time of presentation, willing to accept and cooperate with the treatment, and completed the treatment; (4) The clinical data were completely preserved.

Exclusion criteria: (1) The sufferers who were complicated with severe infection; (2) The sufferers with mental and cognitive disorders; (3) The patients who were complicated with malignant tumor; (4) Pregnant or lactating women.

1.2 Methods

The control one was given drug therapy after treatment, and the traditional Chinese medicine Paishi granules (5g in each bag) was selected. The medicine was administered three times a day, one bag each time, and washed with boiling water.

The sufferers in the research one were received in extracorporeal shock wave lithotripsy after treatment. According to the location of stones determined by color Doppler ultrasound, the patients were guided to choose the appropriate body position. Patients with kidney stones, upper and middle ureteral calculi chose the lateral position, and patients with lower ureteral calculi chose the prone position. The sufferers were treated with extracorporeal shock wave lithotripsy, and the number of shock waves per time was about 1600 to 2400, and the impact times of gravel were determined according to the stone diameter.

During the therapy of the 2 groups of sufferers, the patients were instructed to pay attention to drinking water after meals, the amount of drinking water should reach 500ml, and about 10 times of jumping exercise should be carried out at the same time.

1.3 Observation indicators

To compare the stone free rate, stone removal time and frequency of adverse reactions between the 2 groups, and compare the serum inflammatory factors, symptom scores, comfort score, psychological scores, sleep status indicators and life quality scores at pre-therapy and post-therapy between the 2 groups.

Serum inflammatory factors: venous blood collection was carried out on the patients at fasting, 5ml of blood was collected from the anterior elbow vein. Blood samples were centrifuged at a speed of 3000 rpm, a time of 10 min, and a centrifugal force of 900g. Serum was taken as the test samples for inflammatory factors, including C-reactive protein (CRP), procalcitonin (PCT), and tumor necrosis factor -α(TNF-α). The corresponding detection methods were immunoturbidimetry, immunochromatography and enzyme-linked immunosorbent assay.

Symptoms: the severity of various symptoms of urinary calculi, such as renal colic, hematuria and dysuria, was evaluated in patients. Likert 4-grade scoring method was used to score the evaluation. The score of 0 indicated no symptoms, and 1, 2 and 3 respectively indicate mild, moderate and severe symptoms. The point was greater, the symptoms was more serious.

Comfort: for the evaluation of the patients' comfort, the main tool was the GCQ general comfort scale. The scale has 28 items ranging between one and four, and the all points range between 28 and 112. The score was greater, the comfort was greater.

Psychology: the psychological evaluation indicators usually include two points of depression and anxiety. The evaluation tools were the self rating Anxiety Scale and self rating Depression Scale compiled by Professor Zung. The maximum score is set to 100. The score is inversely proportional to whether the psychology is healthy, that is, the greater the point, the less optimistic the psychological health.

Sleep: the sleep latency and actual sleep duration at night were monitored in patients. Polysomnography was used to monitor the sleep data of patients at night. At the same time, the sleep quality of patients was scored at night. Pittsburgh sleep quality index (PSQI) scale was used to evaluate the sleep quality of sufferers. The

maximum score was set at 21 points. The point was greater, the problems encountered during sleep was more serious at night.

Life quality point: the life quality assessment tool was the WHO Quality of Life Instrument Brief version (WHOQOL-BREF), which sets the maximum score of the four aspects of physiology, psychology, environment and social relations as 100 points. The point was greater, the life quality level was higher.

1.4 Statistical methods

SPSS 22.0 software was used in the statistical analysis of data. And χ^2 test was used in the comparison of count data, t test was selected when comparing the measurement data, and $p<0.05$ indicated that the distinction between the data was statistically obvious.

2 RESULTS

2.1 The stone free ratio and stone removal time compared between the 2 groups

The stone free rate and stone removal time were compared between the 2 groups. The stone free ratio in the research one was greater ($p<0.05$), and the stone removal time in the research one was shorter than the control one ($p<0.05$). See Table 1 and Figure 1-2:

Table 1 The stone free rate and stone removal time compared between the 2 groups

group	Number of cases	Stone free rate	Stone removal time (d)
control group	1000	962 (96.20%)	5.64 ± 1.11
Research Group	1000	987 (98.70%)*	4.21 ± 0.96*

Note: * that is, compared with the control group, $p<0.05$.

Figure 1 Pie chart of the number of stone free cases in the two groups

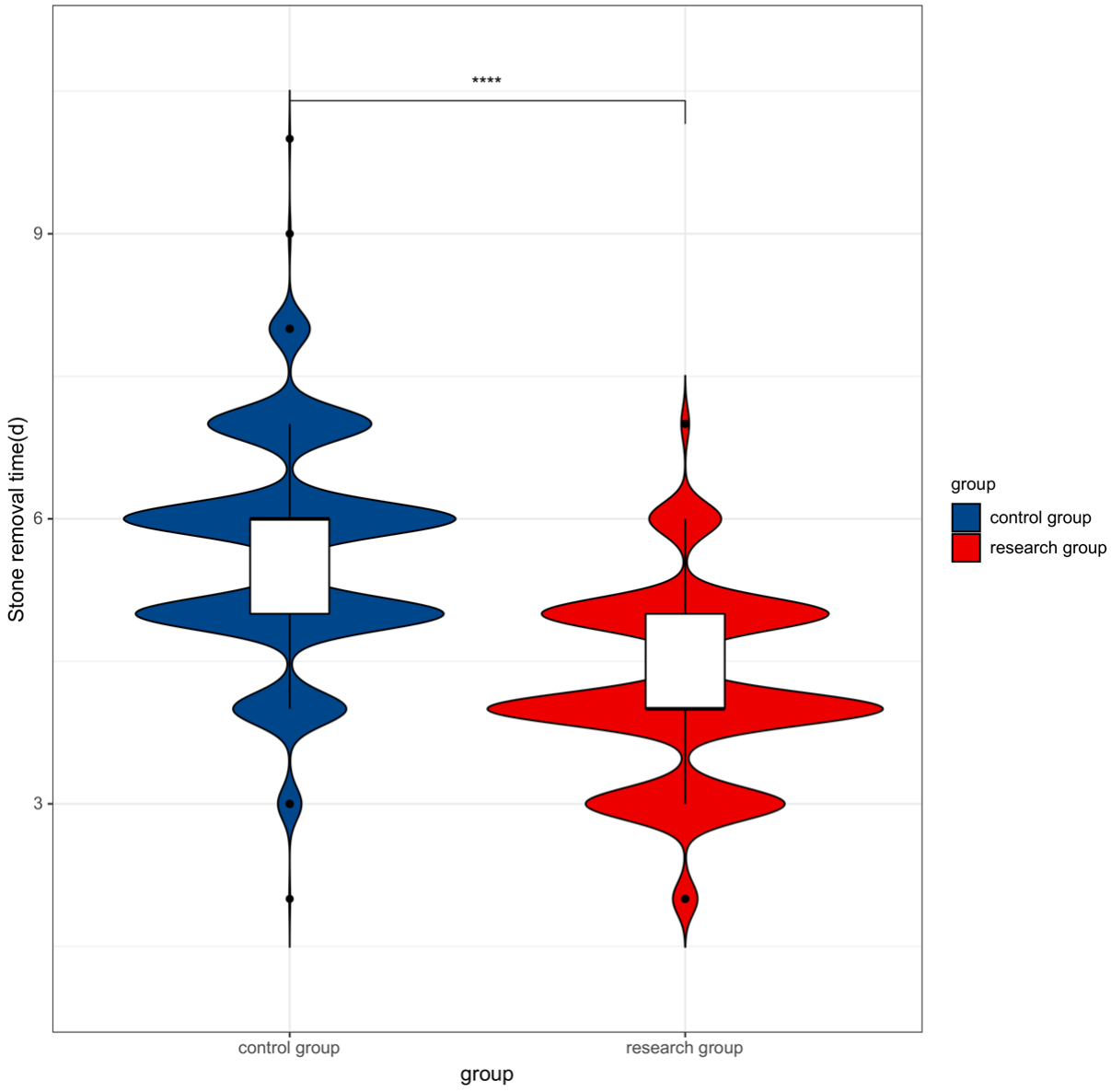

Figure 2 Histogram of two groups of stone removal time

2.2 The frequency of adverse reactions compared between the 2 groups

There had no obvious distinction in the frequency of adverse reactions between the research one and the control one (p>0.05). See Table 2 and Figure 3:

Table 2 The frequency of adverse reactions compared between the 2 groups [n (%)]

group	Number of cases	dizziness	nausea	Peripheral tissue damage
Control group	1000	2 (0.20%)	4 (0.40%)	0 (0%)
Research Group	1000	0 (0%)	0 (0%)	3 (0.30%)

Figure 3 Pie chart of the occurrence of adverse reactions in the 2 groups

2.3 The serum inflammatory factors compared between the 2 groups

After therapy, compared with the levels of pre-treatment serum inflammatory factor indicators CRP, PCT, TNF- α before the treatment, the measured values of the 2 groups were obviously decreased, while the values of the above indicators in the research one were less than the control one (p<0.05). See Table 3 and Figure 4:

Table 3 The serum inflammatory factors compared between the 2 groups ($\bar{x} \pm s$)

group	time	CRP (mg/l)	PCT (ng/ml)	TNF- α (mg/l)
Control group	Before treatment	9.83 ± 1.61	1.35 ± 0.40	16.81 ± 3.10
(n=1000)	After treatment	7.02 ± 1.27#	0.69 ± 0.23#	13.49 ± 2.46#
Research group	Before treatment	9.72 ± 1.64	1.34 ± 0.43	16.62 ± 3.12
(n=1000)	After treatment	5.89 ± 1.06#*	0.46 ± 0.15#*	10.83 ± 2.07#*

Note: # refers to the comparison with that before therapy($p<0.05$), * refers to the comparison with that of the control group ($p<0.05$).

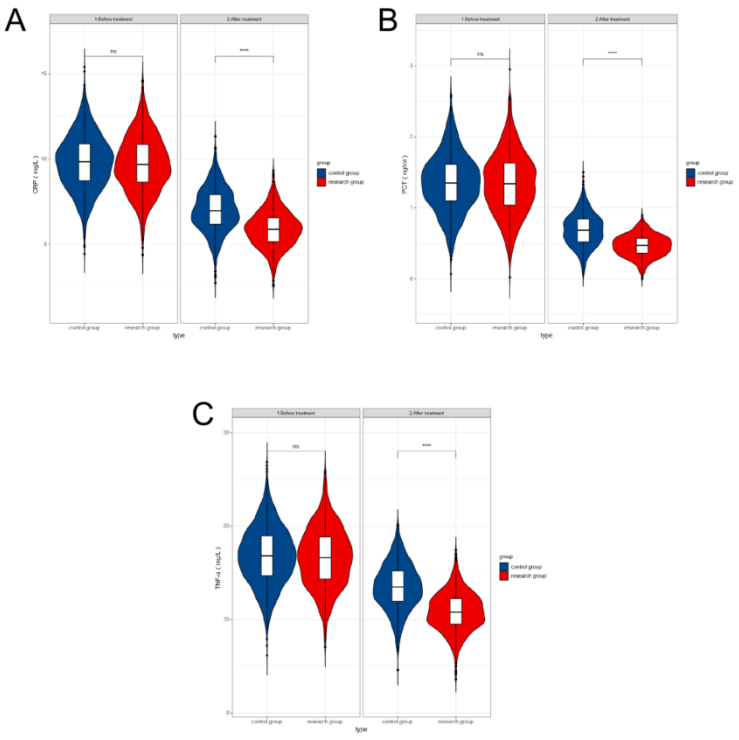

Figure 4 Histogram of serum inflammatory factors in 2 groups

2.4 The symptom points compared between the 2 groups

After therapy, the points of renal colic, hematuria, dysuria and other symptoms of sufferers in the 2 groups were obviously less than those at pre-therapy, while compared with the control group, the points of various symptoms in the study group were lower ($P<0.05$). See Table 4 and Figure 5:

Table 4 The symptom scores compared between the 2 groups ($\bar{x} \pm s$, points)

group	time	Renal colic	hematuria	Dysuria

Control group (n=1000)	Before therapy	2.12 ± 0.50	2.03 ± 0.47	2.17 ± 0.54
	After treatment	1.57 ± 0.53#	1.51 ± 0.57#	1.61 ± 0.55#
Research group (n=1000)	Before treatment	2.14 ± 0.52	2.04 ± 0.50	2.21 ± 0.61
	After therapy	1.16 ± 0.47#*	1.05 ± 0.33#*	1.15 ± 0.49#*

Note: # refers to the comparison with that before therapy ($p<0.05$), * refers to the comparison with the control group ($p<0.05$).

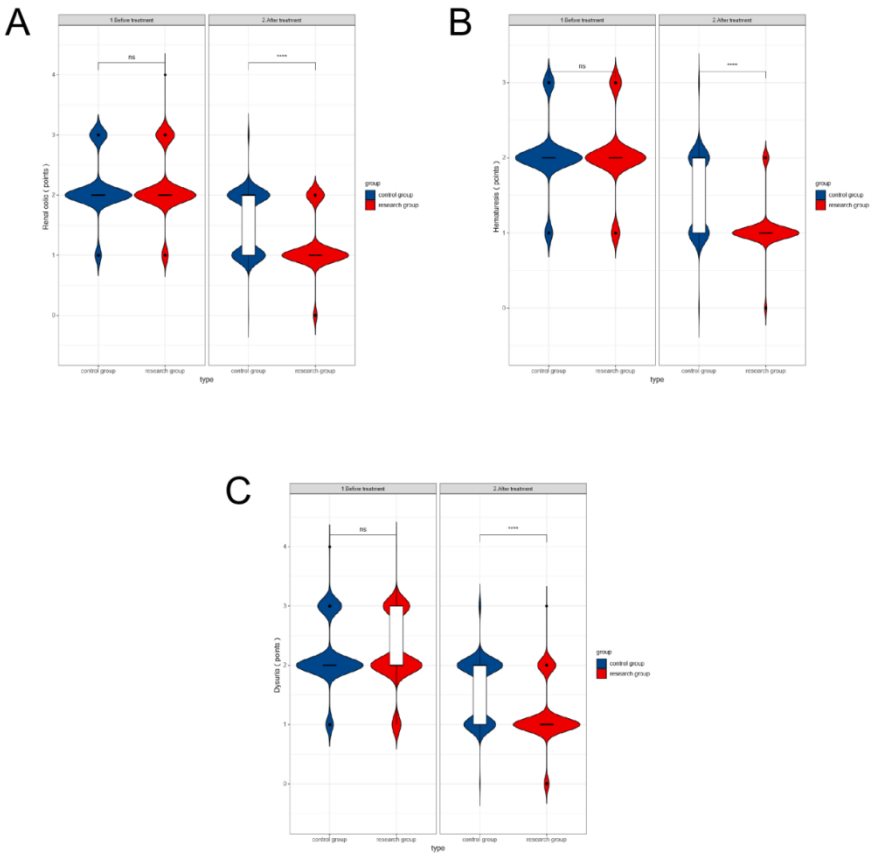

Figure 5 Histogram of symptom scores of two groups

2.5 Comparison of comfort and psychological points between the 2 groups

After therapy, compared with the points of comfort and psychological assessment before treatment, the points of the 2 groups were significantly improved,

while compare to the control one, the points of comfort assessment in the research one were greater, and the scores of the two psychological assessments in the research one were lower (P<0.05). See Table 5 and Figure 6:

Table 5 Comparison of comfort and psychological points between the 2 groups ($\bar{x} \pm s$, points)

group	time	Comfort score	Anxiety score	Depression score
Control group (n=1000)	Before treatment	81.39 ± 5.98	54.38 ± 4.47	56.27 ± 5.10
	After treatment	93.25 ± 6.31#	45.61 ± 3.96#	46.99 ± 4.39#
Research group (n=1000)	Before treatment	81.66 ± 6.16	54.20 ± 4.58	56.04 ± 5.24
	After treatment	102.33 ± 6.12#*	40.89 ± 3.75#*	41.85 ± 3.82#*

Note: # refers to the comparison with that before therapy (p<0.05), * refers to the comparison with that of the control group (p<0.05).

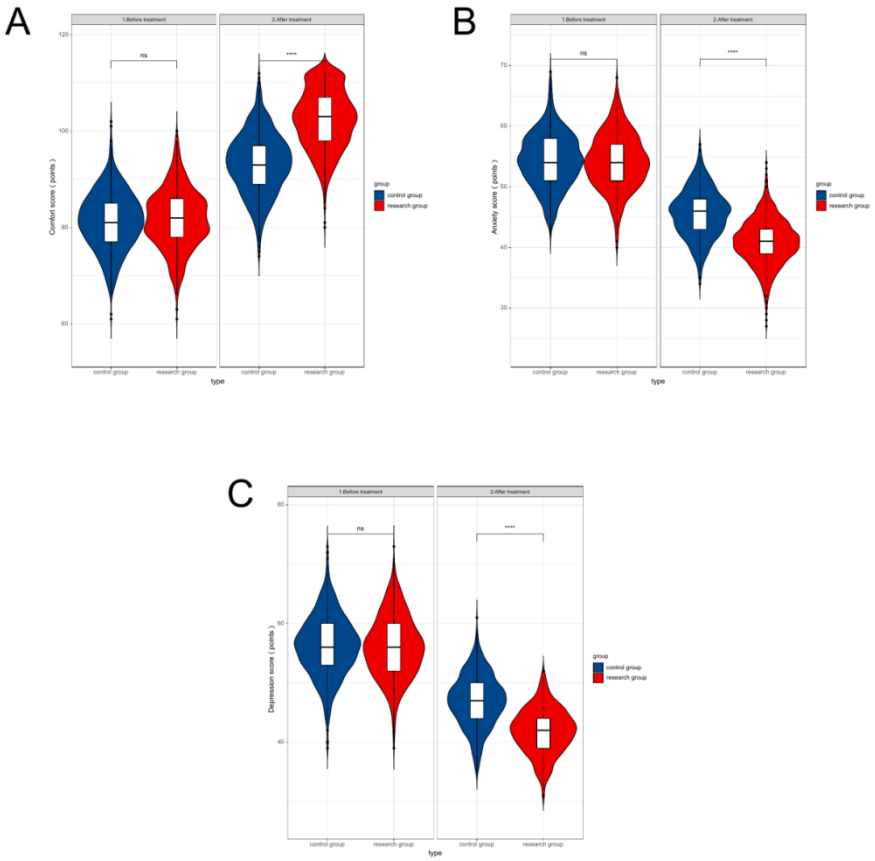

Figure 6 Histogram of comfort and psychological scores of the 2 groups

2.6 The sleep status indicators compared between the 2 groups

After treatment, compared with the indicators of night sleep monitored in the control one, the data of sleep latency and actual sleep duration in the study group were better, and the point of sleep quality in the research one was lower, while the sleep related data monitored and evaluated at night in the 2 groups were all obviously improved than those at pre-therapy (P<0.05). See Table 6 and Figure 7:

Table 6 The sleep status indicators compared between the 2 groups ($\bar{x} \pm s$)

group	time	Sleep latency (min)	Actual sleep duration (H)	Sleep quality score (points)
Control group	Before treatme	64.45 ± 12.72	4.15 ± 1.17	15.22 ± 2.36

(n=1000)	nt			
	After treatment	42.64 ± 8.75#	6.81 ± 1.06#	12.36 ± 1.60#
	Before treatment	64.02 ± 12.57	4.20 ± 1.20	15.05 ± 2.43
Research group (n=1000)	After treatment	33.80 ± 7.94#*	7.86 ± 0.96#*	10.51 ± 1.34#*

Note: # refers to the comparison with that before therapy ($p<0.05$), * refers to the comparison with that of the control group ($p<0.05$).

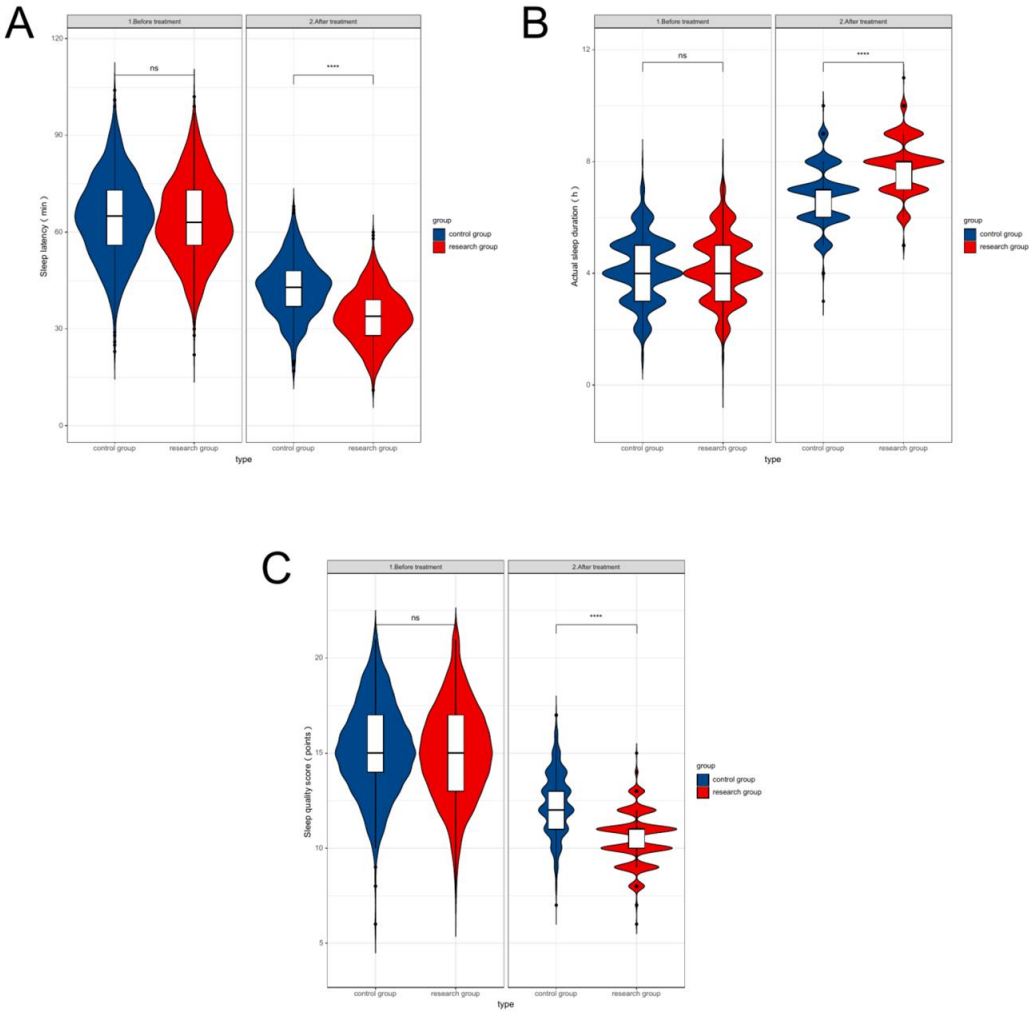

Figure 7 Histogram of sleep status indicators in two groups

2.7 The life quality scores compared between the 2 groups

After therapy, the points of all aspects of life quality of sufferers in the 2 groups were obviously greater than those at pre-therapy and the points of quality of life in the research one were greater than the control one after comparison between the 2 groups (P<0.05). See Table 7 and Figure 8:

Table 7 The life quality points compared between the 2 groups ($\bar{x} \pm s$, points)

group	time	physiology	psychology	environment	social relations
Control group (n=1000)	Before treatment	74.20 ± 5.31	73.64 ± 5.28	74.52 ± 5.20	74.39 ± 5.02
	After treatment	82.92 ± 6.80#	82.40 ± 6.12#	83.27 ± 6.24#	83.11 ± 6.49#
Research group (n=1000)	Before treatment	74.67 ± 5.14	73.90 ± 5.20	74.81 ± 5.25	74.75 ± 5.09
	After treatment	89.56 ± 6.12#*	88.99 ± 5.84#*	90.04 ± 5.93#*	89.83 ± 5.99#*

Note: # refers to the comparison with that before therapy (p<0.05), * refers to the comparison with that of the control group (p<0.05).

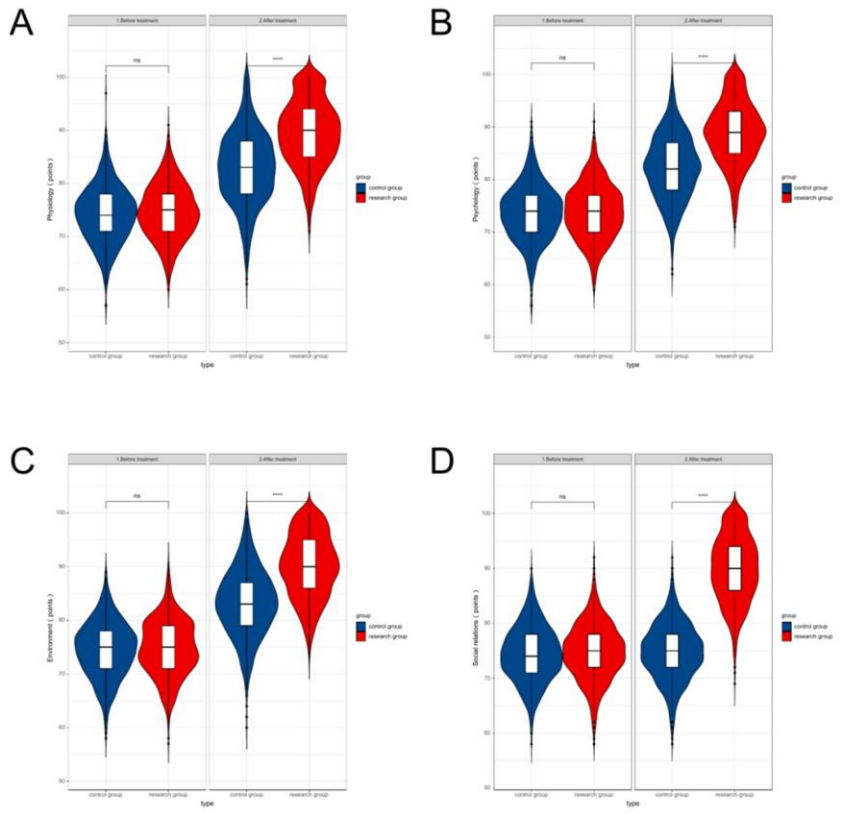

Figure 8 Histogram of life quality points of the 2 groups

3 DISCUSSION

Urinary calculi refers to stone lesions caused by long-term precipitation of urine in the urinary system, with high risk in young and middle-aged people [10-12]. After the occurrence of urinary calculi such as ureteral calculi and renal calculi, patients will have symptoms of hematuria and renal colic, in strenuous exercise or labor symptoms will be aggravated, and will be accompanied by dysuria, which will seriously interfere with the daily life of sufferers and obviously decrease the life quality [13-15].

Surgery can play a good role in removing urinary calculi [16-17]. However, because surgery is invasive to the patients' body, it will cause certain trauma to the patients' body. In addition, double-J tube needs to be indwelled after surgery, which is easy to cause infection. Therefore, surgical treatment is not recommended as the first choice for patients with urinary calculi. Surgical treatment is usually used in patients with urinary calculi who fail non-surgical treatment.

The treatment principle of urinary calculi is to expel the stones and relieve the symptoms. The non-surgical treatment is mainly based on drug therapy and physical therapy, both of which are minimally invasive. Among them, Paishi granules are usually selected for drug lithotripsy treatment. As a Chinese patent medicine, the effective components of Paishi granules are plantago seed, glechoma longituba, talc, Caulis aristolochiae manshuriensis, etc., which have the influences of clearing away heat and diuresis, removing water and removing stones. It is mainly used in patients with urinary calculi accompanied by renal colic and dysuria, which can promote the discharge of stones to a certain extent. Drug lithotripsy treatment can usually play a good role in removing stones with small diameter, but for stones with diameter greater than 7mm, the lithotripsy effect of drug is not ideal, and it is prone to the situation that stones cannot be discharged.

In recent years, extracorporeal shock wave lithotripsy has become the preferred method for the therapy of urinary stone. This treatment method belongs to physical therapy. It mainly uses ultrasound to determine the distribution position of patients' stones in the urinary system, and then uses the shock wave generated by the shock wave lithotriptor to crush the stones distributed in the patients' urinary system in vitro, so that the crushed particles of stones can be naturally discharged through the urine. This method of stone removal is easy to operate and will not cause trauma to the body of patients [18-20]. Compared with drug lithotripsy, extracorporeal shock wave lithotripsy can crush and expel stones with larger diameter, which is usually suitable for the therapy of urinary stones with a diameter of 6 to 15 mm. In order to explore the role of extracorporeal shock wave lithotripsy in the therapy of urinary stone, this study carried out drug lithotripsy and extracorporeal shock wave lithotripsy for two groups of sufferers with urinary stone respectively. After retrospective analysis and comparison of the implementation of the two treatment schemes, the following results were obtained: (1) The stone free ratio and stone removal time were compared between the 2 groups, and the stone free ratio in the research one was greater ($p<0.05$), the stone removal time in the research one was shorter than the control one ($p<0.05$).

After treatment, in comparison of the control one, the measured values of serum inflammatory factors were lower in the research one, and the symptom scores were lower in the research one. The score of comfort assessment in the research one was higher, and the points of two psychological assessments in the research one were lower. The data of sleep latency and actual sleep duration in the study group were better, and the point of sleep quality in the research one was lower, and the points of life quality in the research one were higher (all $P<0.05$). These data indicate that the impact of stone removal of extracorporeal shock wave lithotripsy for urinary stone are significantly better than that of drug lithotripsy, which can discharge calculi more quickly and effectively, reduce the residual stones. It can relieve renal colic, hematuria, dysuria and other symptoms caused by urinary calculi, and reduce the inflammatory reactions of the urinary system. So that the patients' physical discomfort can be significantly reduced. And it can avoid the continue occurrence of patients' psychological adverse emotions, sleep disorders, and decreased quality of life and other situations due to the patients' condition. The reasons are as follows: the drug lithotripsy treatment mainly uses drugs to gradually discharge the stones, but the stones in this treatment are not crushed, their volume is relatively larger, and the effect of natural discharge through urine is not good. While extracorporeal shock wave lithotripsy (ESWL) can crush urinary calculi into small particles by shock wave, which can significantly reduce the volume of stones and the difficulty of discharging through the urinary tract, so as to achieve a better effect of stone removal, and the speed of stone removal is relatively accelerated. (2) As for the incidence of adverse reactions, no obvious distinction was found between the 2 groups ($P > 0.05$), indicating that the safety of extracorporeal shock wave lithotripsy and drug lithotripsy in the therapy of urinary stone is equivalent, and there were no obvious adverse reactions. The reasons are as follows: the Paishi granules used in drug treatment are Chinese patent medicine, the effective ingredients are Chinese herbal medicine, and the side effects are relatively small. Extracorporeal shock wave lithotripsy uses the energy of shock wave to complete the lithotripsy treatment, without invasive

operation on the patients' body, with good safety. Patients with poor tolerance, elderly patients or patients with a variety of basic diseases can also accept extracorporeal shock wave lithotripsy treatment.

To sum up, after the onset of urinary calculi in patients, extracorporeal shock wave lithotripsy can achieve better stone removal effect than conventional drug treatment. It can discharge calculi more quickly, reduce the symptoms and inflammatory reactions of sufferers, decrease the physical discomfort of sufferers, and improve their psychological, sleep and life quality The application of extracorporeal shock wave lithotripsy does not increase the risk of adverse reactions, with good safety. Therefore, extracorporeal shock wave lithotripsy can be widely used in the therapy of urinary stone.

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Corresponding Author:

Siwen Ddeng

Department of Urology, Wuhan Dongxihu District People's Hospital, Hubei 430040, China

E-mail: yjb13986042816@163.com