Therapeutic effect evaluation of TUPKEP combined with percutaneous cystotomy and nephroscopic EMS minimally invasive therapy for benign prostatic hyperplasia with multiple large bladder calculi

Zhi-Hu Zhu, Bing-Xun He, Hou-Bin Kang

Urinary Surgery Department, the Second People's Hospital of Liangshan Yi Autonomous Prefecture Sichuan Province, Xichang City, Sichuan Province, 615000

ARTICLE INFO ABSTRACT

Objective: To study the therapeutic effect of TUPKEP combined with nephroscopic EMS pneumatic minimally invasive therapy for benign prostatic hyperplasia with multiple large bladder calculi. Methods: Benign prostatic hyperplasia patients with multiple (large) bladder calculi who received surgical treatment in our hospital from May 2012 to October 2015 were selected as the research subjects and randomly divided into TUPKEP group and TURP group, and then perioperative situation, serum PSA levels, liver and kidney function and the degree of inflammation were compared between two groups. Results: During operation, the amount of bleeding and the weight of removed prostate of TUPKEP group were significantly lower than those of TURP group; during postoperative recovery, the time of retention catheterization of TUPKEP group was shorter than that of TURP group; 1 d, 3 d and 7 d after operation, serum PSA levels of both groups were significantly higher than those before operation and serum PSA levels of TUPKEP group were significantly lower than those of TURP group; 3 days after operation, ALT, AST, BUN and Scr levels of TUPKEP group and TURP group were not different, and IL-1β and IL-18 levels in serum as well as mRNA levels of NLPR3, ACS, Caspase-1, IL-1β and IL-18 in peripheral blood mononuclear cells of TUPKEP group were significantly lower than those of TURP group. Conclusion: TUPKEP combined with nephroscopic EMS pneumatic minimally invasive therapy for benign prostatic hyperplasia with multiple large bladder calculi causes less damage, has better resection effect on the hyperplastic gland tissue than TURP, and has equivalent long-term curative effect to TURP.

1. Introduction

Benign prostatic hyperplasia (BPH) is a common cause of urination disorders in older men, and more than 10% of BPH patients were complicated with bladder calculi[1]. Long-term retention of urine crystals, cells and small stones in the bladder caused by lower urinary tract obstruction in BPH patients is the main cause of bladder calculi, and at the same time, it will also increase the risk of secondary infection[2–3]. In clinical practice, the main means to treat prostatic hyperplasia with bladder calculi is transurethral resection of prostate (TURP) with lithotomy. Fourth-generation EMS pneumatic and ultrasound lithotripsy system combined with nephroscopy can effectively remove multiple stones and large stones in bladder[4], and after lithotripsy, intraoperative transurethral stone removal will increase the damage of TURP surgery to local prostate tissue and urinary tract tissue[5].

Transurethral plasma kinetic enucleation of prostate (TUPKEP) is a new way to treat BPH developed in recent years, and it has clearer intraoperative view, more trenchant anatomical level exposure and higher accuracy of operation[6]. For the surgical treatment of prostatic hyperplasia with multiple large bladder stones, nephroscopic EMS pneumatic minimally invasive lithotripsy combined with TUPKEP operation is expected to cause relatively less surgical trauma[7]. In the following study, the therapeutic effect of TUPKEP combined with nephroscopic EMS pneumatic minimally invasive therapy for benign prostatic hyperplasia with multiple large bladder calculi was analyzed.
2. Subjects and methods

2.1. Research subjects

The subjects of the study were 54 cases of benign prostatic hyperplasia patients with multiple large bladder calculi who received surgical treatment in our hospital from May 2012 to October 2015, received digital rectal examination, urinary color Doppler and urinary tract CT before operation and were clearly diagnosed with benign hyperplasia of prostate and multiple large bladder stones, and the diameter of stones was ≥2 cm. Random number table was used to divide the included patients into TUPKEP and TURP group (n=27). TUPKEP group received TUPKEP combined with nephroscopic EMS pneumatic minimally invasive lithotripsy, they were (67±9) years old, 16 cases had multiple bladder calculi with diameter more than 1 cm, 11 cases had single stone with every radial line diameter > 3 cm, the largest stone diameter was 5.3 cm, and the prostate volume was (97.2±11.3) mL; TURP group received TURP combined with nephroscopic EMS pneumatic minimally invasive lithotripsy, they were (68±8) years old, 18 cases had multiple bladder calculi with diameter more than 1 cm, 9 cases had single stone with every radial line diameter > 3 cm, the largest stone diameter was 5.5 cm, and the prostate volume was (99.1±10.8) mL. The comparison of general data between two groups showed no significant difference.

2.2. Treatment methods

Both groups received nephroscopic EMS pneumatic minimally invasive lithotripsy at first, and the method was as follows: resectoscope was embedded into the bladder through urethra, and monitored by resectoscope, suprapubic cystotomy was conducted, telescopicform metal expander was inserted, fistula orifice was expanded to F22 size, then F24 nephroscope short sheath was inserted through the fistula orifice, nephroscope was used to lightly press the stones and fix them in the bladder trigone, pneumatic and ultrasound lithotripsy was used to smash the stones, EMS vacuum suction system was used to suck out the broken stones, or cutting loops could be used to get out the stone fragments. After lithotripsy, TUPKEP group received transurethral plasma kinetic enucleation of prostate, GYRUS plasma kinetic resection system was used for resection, the power of electric resection was 160 W, the power of electric coagulation was 80 W, the flushing fluid was normal saline, the flushing height was 60 cm, verumontanum was used as the sign to find the space between prostate glands and surgical capsule in reverse way, the gland was entirely stripped to the vesical neck until there was only a little tissue connected to the vesical neck, and then the stripped glands underwent electric resection one by one. TURP group received regular transurethral resection of prostate, the power of electric resection was set to140-160 W, the power of electric coagulation was 60-70 W, 5% glucose solution was used as the flushing fluid, the glands were cut in 5-7 o’clock position at first, from the vesical neck to the superior border of verumontanum, the depth should reach surgical capsule as far as possible, and the prostate tissue in 12 o’clock position was treated at last.

2.3. Perioperative situation evaluation methods

During operation, the operation field of prostate capsule exposure and the operation field of hemostasis during resection of two groups were recorded; the operation time, intraoperative amount of bleeding and the weight of removed prostate were recorded; the duration of retention catheterization in the process of recovery was followed up during postoperative hospital stay; 6 months after operation, patients were followed up and international prostate symptom score (IPSS) was used to evaluate the symptoms of prostatic hyperplasia.

2.4. Serum biochemical index evaluation methods

Before operation as well as 1 d, 3 d, 7 d and 1 month after operation, 5-10 mL of peripheral blood was collected from the two groups of patients respectively and centrifuged to get serum; serum specimens before operation as well as 1 d, 3 d, 7 d and 1 month after operation were taken, automatic biochemical analyzer was used to determine alanine aminotransferase (ALT), aspartate aminotransferase (AST), blood urea nitrogen (BUN) and serum creatinine (Scr) levels, and enzyme-linked immunosorbent assay kits were used to determine prostate-specific antigen (PSA) levels; the serum samples 3 days after operation were taken, automatic biochemical analyzer was used to determine alanine aminotransferase (ALT), aspartate aminotransferase (AST), blood urea nitrogen (BUN) and serum creatinine (Scr) levels, and enzyme-linked immunosorbent assay kits were used to determine IL-1β and IL-18 levels. Peripheral blood 3 d after operation was collected to separate mononuclear cells, then RNA was extracted, and fluorescence quantitative PCR kits were used to determine the mRNA levels of NLPR3, ACS, Caspase-1, IL-1β and IL-18.

2.5. Statistical methods

SPSS 20.0 software was used to input and analyze data, measurement data analysis was by t test and P<0.05 indicated statistical significance in differences.

3. Results

3.1. Intraoperative field of two groups

Intraoperative field of prostate capsule and gland exposure of TUPKEP group could clearly distinguish the prostate capsule and glands; the field of prostate capsule and gland exposure of TURP group was relatively poor. Intraoperative field of the exposure of blood vessels between the capsule and glands as well as the hemostasis of TUPKEP group could clearly show the blood vessels and conduct electric coagulation, and the wound bleeding was less; the field of blood vessel exposure of TURP group was relatively poor, and the wound bleeding was more. The time of operation of TUPKEP group was (59.5±7.8) min, and not significantly different from (61.3±8.2) min of TURP group; intraoperative amount of bleeding of TUPKEP group was (93.4±10.2) mL, the weight of removed prostate was (36.1±6.2) g, and both were significantly better than (151.8±32.2) mL and (22.1±4.8) g of TURP group.

3.2 Postoperative situation of two groups

During postoperative recovery, the time of retention catheterization of TUPKEP group was (3.86±0.61) d and significantly shorter than (5.93±0.85) d of TURP group, and differences between two groups were significant, t=6.915, P<0.05; 6 months after operation, IPSS of TUPKEP group was (5.92±0.82) points and not significantly different from (5.87±0.79) points of TURP group, t=0.184, P>0.05.

3.3 Perioperative serum PSA levels of two groups
Before operation, serum PSA levels of TUPKEP group and TURP group were not significantly different (P>0.05). 1 d, 3 d and 7 d after operation, serum PSA levels of both groups were significantly higher than those before operation, and differences within group at different points of time were significant (P<0.05). serum PSA levels of TUPKEP group were significantly lower than those of TURP group, and differences between two groups at the same point in time were significant (P<0.05). 1 month after operation, serum PSA levels of both groups were not significantly different from those before operation, and serum PSA level of TUPKEP group 1 month after operation was not significantly different from that of TURP group (P>0.05).

3.4. Postoperative liver and kidney function of two groups

3 d after operation, ALT (26.47±5.12 vs. 25.61±4.88 U/L), AST (22.15±3.92 vs. 22.82±4.27 U/L), BUN (5.82±0.79 vs. 5.68±0.72 mmol/L) and Scr (71.42±9.62 vs. 72.63±10.15 μmol/L) of TUPKEP group and TURP group were not significantly different (P>0.05). 1 d, 3 d and 7 d after operation, ALT (26.14±5.52 vs. 16.59±2.11 μmol/L) and Scr (41.33±5.28 vs. 6.02±0.78 μmol/L) of TUPKEP group and TURP group were significantly different (P<0.05). 1 month after operation, serum PSA levels of both groups were significantly lower than those before operation, and differences within group at different points of time were significant (P<0.05). Serum PSA level of TUPKEP group 1 month after operation was not significantly different from that of TURP group (P>0.05).

3.5. Postoperative inflammatory state of two groups

3 d after operation, serum IL-1β and IL-18 levels of TUPKEP group were significantly lower than those of TURP group, and the mRNA levels of NLPR3, ACS, Caspase-1, IL-1β and IL-18 in peripheral blood mononuclear cells were significantly lower than those of TURP group.

4. Discussion

The main treatment for bladder calculi is transurethral lithotripsy, which smashes the stones from lateral side, is unable to conduct effective intravesical fixation, and increases the surgical operation difficulty. For patients with prostatic hyperplasia, hyperplastic prostate intrusion into the bladder can cause the formation of "blind Angle" between glands and trigone, further increasing the operation difficulty; in addition, the endoscope system needs to be in and out of the urethra repeatedly, it will increase the bleeding on the surface of the prostate, and the amount of bleeding in prostate surgery increases. Swiss fourth-generation EMS ultrasound and pneumatic lithotripsy system centralizes pneumatic ballistic, ultrasound and vacuum suction, its main advantages lie in the stone removal removal by initiative vacuum suction function and the improvement of stone removal rate per unit time. In our hospital, percutaneous cystotomy was adopted to break bladder calculi through cystotomy channel, it can effectively fix the stones in posterior wall of urinary bladder, reduce stone activity and improve the efficiency of lithotripsy, and meanwhile, pneumatic combined with ultrasound lithotripsy was used to smash the stones, clear the stones through vacuum suction and remove the stones through resectoscope channel, significantly improving the efficiency of stone removal. After the EMS lithotripsy, TUPKEP or TURP was adopted for prostate surgery. TUPKEP and TURP are commonly used operation methods for clinical treatment of prostatic hyperplasia[9,10], prostatectomy was performed in the study after nephrosopic EMS pneumatic lithotripsy, boundaries between capsule and glands were clearer during TUPKEP, blood vessel exposure was clearer, and the amount of bleeding was less during resection. Intraoperative situation analysis showed that during operation, the amount of bleeding and the weight of removed prostate of TUPKEP group were significantly lower than those of TURP group. The comparison of postoperative time of retention catheterization showed that the time of retention catheterization of TUPKEP group was significantly shorter than that of TURP group; comparison of long-term symptoms of prostatic

### Table 1
Comparison of perioperative serum PSA levels of two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Before operation</th>
<th>1 d</th>
<th>3 d</th>
<th>7 d</th>
<th>1 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUPKEP</td>
<td>6.68±0.92</td>
<td>22.69±4.12*</td>
<td>26.14±5.52*</td>
<td>16.59±2.11*</td>
<td>5.83±0.72</td>
</tr>
<tr>
<td>TURP</td>
<td>6.76±0.89</td>
<td>38.36±8.26</td>
<td>50.25±7.87</td>
<td>41.33±5.28</td>
<td>6.02±0.78</td>
</tr>
</tbody>
</table>

Note: (1) compared with same group before operation, P<0.05; (2) compared with TURP group at the same point in time, *P<0.05.

### Table 2
Comparison of postoperative liver and kidney function between two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Liver function</th>
<th>Kidney function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ALT (U/L)</td>
<td>AST (U/L)</td>
</tr>
<tr>
<td>TUPKEP</td>
<td>26.47±5.12</td>
<td>22.15±3.92</td>
</tr>
<tr>
<td>TURP</td>
<td>25.61±4.88</td>
<td>22.82±4.27</td>
</tr>
<tr>
<td>T</td>
<td>0.382</td>
<td>0.217</td>
</tr>
<tr>
<td>P</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

### Table 3
Comparison of postoperative inflammatory state between two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Serum cytokine levels (pg/mL)</th>
<th>mRNA levels of inflammasomes in peripheral blood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IL-1β</td>
<td>IL-18</td>
</tr>
<tr>
<td>TUPKEP</td>
<td>31.54±6.13</td>
<td>156.71±22.36</td>
</tr>
<tr>
<td>TURP</td>
<td>55.26±7.88</td>
<td>221.4±36.25</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
hyperplasia showed that 6 months after operation, IPSS of two groups were not significantly different. It indicated that compared with TURP, TUPKEP had the biggest advantages in obtaining clearer operation field, reducing the difficulty of surgical operation and reducing the wound bleeding, thus shortening the time of postoperative urethral functional recovery and the time of retention catheterization. In spite of this, the long-term curative effect of two groups was basically the same and IPSS was not significantly different, which might be because that TURP operation technology was skilled, and although it caused relatively larger damage and relatively more amount of bleeding, it could still effectively remove hyperplastic gland tissue and improve clinical symptoms.

Prostate-specific antigen (PSA) is a kind of glycoprotein synthesized and secreted by prostate tissue, and because there are apparent tissue barriers among prostate acini, vessel lumen and blood circulation, PSA levels in the blood are relatively low[11,12]. TUPKEP and TURP operations can cause prostate tissue damage and result in massive release of PSA into the blood. In the study, analysis of serum PSA levels of the two groups confirmed that serum PSA levels of both groups 7 d after operation were higher than those before operation and serum PSA level of TUPKEP group was significantly lower than that of TURP group. Thus it confirmed that intraoperative operation of TUPKEP was more precise and caused less damage to normal prostate tissue, and the postoperative serum PSA levels were lower. In order to further clarify the security of TUPKEP and TURP for treatment of prostatic hyperplasia with multiple bladder calculi, postoperative liver and kidney function of two groups were compared. Serum levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are the common clinical indicators to reflect whether there is liver function injury, and the levels of blood urea nitrogen (BUN) and serum creatinine (Scr) are the common indicators to reflect kidney function, especially the glomerular filtration function. Comparison of the above liver and kidney function indexes between two groups showed that ALT, AST, BUN and Scr levels of TUPKEP group 3 d after operation were not significantly different from those of TURP group.

Although the effect of TUPKEP and TURP on the liver and kidney function of prostatic hyperplasia patients with multiple bladder stones was not significantly different, the comparison from intraoperative field exposure, the wound bleeding and postoperative time of retention catheterization could make clear that the degree of trauma of TUPKEP was weaker than that of TURP. When the body suffers from trauma, inflammation is apparently activated, and slight trauma can cause the synthesis and release of a variety of inflammatory factors[13]. NLRP3 inflammasomes are the inflammation-regulating mechanism discovered in recent years, and NLRP3 recruits ASC to activate Caspase-1, thereby making precursor pro-IL-1β and pro-IL-18 split into mature IL-1β and IL-18[14,15]. Serum IL-1β and IL-18 levels can reflect the degree of inflammation, and can also reflect slight trauma extent. In the study, the IL-1β and IL-18 levels in serum as well as NLRP3 inflammasome levels in peripheral blood were analyzed, and the results showed that serum IL-1β and IL-18 levels of TUPKEP group were significantly lower than those of TURP group, and the mRNA levels of NLRP3, ACS, Caspase-1, IL-1β and IL-18 in peripheral blood mononuclear cells were significantly lower than those of TURP group. It confirmed that TUPKEP caused less damage to prostatic hyperplasia patients with multiple bladder calculi than TURP.

To sum up, TUPKEP combined with percutaneous cystotomy and nephroscopic EMS pneumatic minimally invasive therapy for benign prostatic hyperplasia with multiple large bladder calculi causes less damage, has better resection effect on the hyperplastic gland tissue than TURP, and has equivalent long-term curative effect to TURP.

References