Assessment of the extent of trauma in single-port retroperitoneal laparoscopic surgery and percutaneous nephrolithotomy treatment of upper ureteral calculi

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ARTICLE INFO

Article history:
Received 8 Jul 2016
Received in revised form 19 Jul 2016
Accepted 11 Jul 2016
Available online 24 Jul 2016

Keywords:
Upper ureteral calculi
Single-port retroperitoneal laparoscopic surgery
Percutaneous nephrolithotomy

ABSTRACT

Objective: To compare the extent of trauma between single-port retroperitoneal laparoscopic surgery and percutaneous nephrolithotomy treatment of upper ureteral calculi. Methods: A total of 118 cases of patients with upper ureteral calculi who underwent surgical treatment in our hospital from December 2013 to February 2016 were included in the study and divided into observation group and control group (n=59) according to random number table, control group received percutaneous nephrolithotomy, observation group received single-port retroperitoneal laparoscopic surgery, and then differences in early postoperative inflammation, pain-related mediators, trauma-related proteins, biological effects of the pancreas and so on were compared between two groups. Results: Early postoperative WBC, CRP, PET, COR, FT3 and NE levels of observation group were lower than those of control group; pain mediators SP, IL-6, SK and NPY levels were lower than those of control group; HMGB-1 and HSP72 levels were lower than those of control group while albumin and prealbumin levels were higher than those of control group; blood amylase and urine amylase levels were lower than those of control group. Conclusion: Single-port retroperitoneal laparoscopic surgery for treatment of patients with upper ureteral calculi has positive effect on reducing surgical trauma, avoiding pancreatic trauma and other aspects, and has more clinical advantages than percutaneous nephrolithotomy.

1. Introduction

Upper ureteral calculus is the most common clinical urinary system disease, and surgical removal is the most radical treatment. The choice of specific operation methods should not only follow the principle of efficiency, but also reduce surgical trauma as far as possible in order to reduce postoperative pain and promote postoperative recovery. Both single-port retroperitoneal laparoscopic surgery and percutaneous nephrolithotomy are common surgical methods for clinical treatment of upper ureteral calculi, percutaneous nephrolithotomy has the most application and reliable stone-removal effect, but it is with longer subcutaneous tunnel and bigger surgical trauma[1]; single-port retroperitoneal laparoscopic surgery has smaller surgical space, but those who master the technology can skillfully avoid important abdominal viscera, and it also has significant advantages in separating renal pedicle vessels and reducing the bleeding volume[2,3]. In the study, the extent of trauma between single-port retroperitoneal laparoscopic surgery and percutaneous nephrolithotomy treatment of upper ureteral calculi was mainly compared, hereby reported as follows.

2. Information and methods

2.1. General information

A total of 118 cases of patients with upper ureteral calculi who underwent surgical treatment in our hospital from December 2013 to February 2016 were included in the study, inclusion criteria: 1) diagnosed by imaging test; 2) patients and families signed consent form. Exclusion criteria: 1) associated with other diseases of ureter and kidney; 2) with heart, lung, liver and other important viscera dysfunction; 3) with acute inflammatory disease; 4) pregnant or
breastfeeding women.

Patients were divided into observation group and control group \((n=59)\) according to random number table, control group included 37 male cases and 22 female cases, they were 37-69 years old and the average was \((50.71±9.37)\) years; observation group included 39 male cases and 20 female cases, they were 35-68 years old and the average was \((49.65±9.11)\) years. Differences in gender, age and other baseline information of two groups were not statistically significant, \(P>0.05\).

2.2. Surgical treatment

Percutaneous nephrolithotomy: patients took lithotomy position after anesthesia, F5 ureteral catheter was guided by ureteroscope and placed into operation-side ureter, and artificial kidney effusion was established. Patients’ position was changed (from lithotomy position to prone position), F18 percutaneous renal tract was established, the target calculi were found, and the calculi were broken and then taken out, indwelling D-J tube and percutaneous renal stoma.

Single-port retroperitoneal laparoscopic surgery: patients lay fully on the healthy side (elevating Waist Bridge) after general anesthesia, and catheter was inserted and clipped to fill the bladder. Oblique incision (length 2-3 cm) was made in midaxillary line costal margin and iliac crest midpoint, retroperitoneal space was bluntly dissociated, a homemade balloon (with 500-800 mL gas injection) was placed, and after 2-3 min oppression, retroperitoneal space was opened to insert Tri-Port. CO₂ pneumoperitoneum machine was connected, the pressure was controlled at about 12 mmHg, and medical T-type three-way valve was used for fog release. Two operation channels were established, pliers and abdominal observation mirror were inserted, the ultrasonic knife was inserted in 10 mm operation channel to cut open perirenal fascia close to the back side, dissociate to the deep and find the target ureter. Target ureter was dissociated and clipped with forceps, ureter proximal to the calculi was fixed, ureteral wall was cut open longitudinally, and the calculi were dissociated, finally taken out and placed in homemade sample bag. Double J tube was placed in the incision, the incision was sutured with absorbable 4-0 suture, and after confirming that there was no leakage of urine, the equipment was removed and the skin incision was interruptedly sutured.

2.3. Observation indexes

2.3.1. Inflammation and stress indicators

5 mL fasting peripheral venous blood was drawn from patients in the morning 1 d after surgery and centrifuged to collect supernatant and measure inflammation-related indicators in it: white blood cells (WBC) and C-reactive protein (CRP) and proealcitonin (PET); stress-related indicators: including cortisol (COR), free triiodothyronine (FT3) and norepinephrine (NE).

2.3.2 Pain mediators

Serum pain-related indicators were determined 1d after surgery, including substance P (SP), interleukin-6 (IL-6), SK and neuropeptide Y (NPY).

2.3.3 Trauma-related proteins

Serum high mobility group protein-1 (HMGB-1), heat shock protein 72 (HSP72), albumin, and prealbumin levels were determined 1d after surgery.

2.3.4 Biological effects of the pancreas

1 d after lithotripsy, peripheral venous blood2ml and urine specimens were collected from patients, and serum amylase and urine amylase levels in them were determined. At the same time, abdominal ultrasound was conducted to observe the pancreas appearance, degree of swelling, echo, etc.

2.4. Statistical methods

Data obtained in the study was analyzed by SPSS 23.0 software, measurement data comparison was by t test, count data comparison was by chi-square test and \(P<0.05\) was set as the standard of statistical significance in differences.

3. Results

3.1. Inflammation and stress indicators

Serum WBC, CRP, PET, COR, FT3 and NE levels of observation group 1 d after surgery were lower than those of control group \((P<0.05)\), shown in Table 1.

3.2. Pain-related mediators

Early postoperative pain mediators such as SP, IL-6, SK and NPY levels of observation group were lower than those of control group \((P<0.05)\), shown in Table 2.

<table>
<thead>
<tr>
<th>Groups</th>
<th>SP (μg/mL)</th>
<th>IL-6 (pg/mL)</th>
<th>SK (μg/L)</th>
<th>NPY (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>8.16±0.94</td>
<td>10.76±1.37</td>
<td>7.46±0.85</td>
<td>153.27±19.61</td>
</tr>
<tr>
<td>Control</td>
<td>11.84±1.94</td>
<td>15.79±2.15</td>
<td>10.74±1.53</td>
<td>231.84±25.93</td>
</tr>
<tr>
<td>(t)</td>
<td>6.834</td>
<td>7.394</td>
<td>8.182</td>
<td>12.943</td>
</tr>
<tr>
<td>(P)</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table 1.

Inflammation and stress indicators of two groups 1 d after surgery.
3.3 Trauma–related proteins

Early postoperative serum HMGB-1 and HSP72 levels of observation group were lower than those of control group while albumin and prealbumin levels were higher than those of control group (P<0.05), shown in Table 3.

<table>
<thead>
<tr>
<th>Groups</th>
<th>HMGB-1 (ng/mL)</th>
<th>HSP72 (μg/mL)</th>
<th>Albumin (g/L)</th>
<th>Prealbumin (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>3.82±0.41</td>
<td>10.47±1.43</td>
<td>43.27±4.03</td>
<td>7.23±0.89</td>
</tr>
<tr>
<td>Control</td>
<td>7.19±0.85</td>
<td>19.66±2.53</td>
<td>35.93±4.11</td>
<td>3.12±0.45</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td></td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

3.4. Biological effects of the pancreas

Blood amylase (563.82±74.03) U/L and urine amylase (372.17±42.85) U/L of observation group 1 d after lithotripsy were lower than blood amylase (923.82±86.67) U/L and urine amylase (732.17±85.31) U/L of control group (P<0.05).

3. Discussion

Ureteral calculi trend to occur in middle-aged and mature men, upper ureteral calculi are the most common, the main symptoms are angina and hematuria, and they may be accompanied by urinary tract obstruction and infection. The treatment purpose of patients with upper ureteral calculi is to remove the cause and prevent the recurrence of calculi, so surgical removal is the best way. Single-port retroperitoneal laparoscopic surgery and percutaneous nephrolithotomy are the most common methods for urinary tract lithotomy, single-port retroperitoneal laparoscopic surgery adopts the retroperitoneal approach of laparoscope, and can directly enter into the surgical field and expose the kidney, and although it lacks clear anatomic landmark and has limited operating space, it is more convenient in treating renal pedicle vessels and causes less surgical bleeding[4,5]. As for percutaneous nephrolithotomy, it has the most wide clinical application, it establishes a channel at the waist from the skin to the kidney, insert nephroscope into the kidney, and then uses laser, ultrasound and other tools to break and remove kidney calculi[6,7]. Studies believe that on the premise of mastering laparoscopic techniques, retroperitoneal laparoscopic surgery is the more ideal way to treat urinary system disease[8,9], so in the study, single-port retroperitoneal laparoscopic surgery was applied in the observation group of patients and then compared with the percutaneous nephrolithotomy in control group to make clear the differences in surgical trauma of the two.

For benign diseases such as ureteral calculi, surgical trauma is the main factor influencing patients’ postoperative recovery, and looking for effective and minimally invasive surgical procedure has been a consistent goal of clinicians and patients. In the study, detection of early postoperative inflammation and stress indicators of two groups at first showed that serum inflammation indicators WBC, CRP and PET as well as stress indicators COR, FT3 and N levels of observation group were lower 1d after treatment, which directly indicated that single-port retroperitoneal laparoscopic surgery caused fewer traumas. Percutaneous nephrolithotomy needs to artificially create a percutaneous renal channel, and causes large subcutaneous wound and more surgical bleeding volume, and compared with single-port retroperitoneal laparoscopic surgery, it causes more traumas, and therefore, the levels of inflammation and stress indicators significantly change in the first place. Trauma and pain have a direct correlation, patients with larger trauma have severe postoperative pain, and the levels of pain-related mediators in their bodies will further change[10]. SP is a neuropeptide widely distributed in nerve fibers, can be released in the centre and peripheral end after nerves are stimulated, and is involved in nociceptive transmission[11]. Neuropeptide Y (NPY) belongs to the pancreatic polypeptide family and is widely distributed in mammalian central and peripheral nervous system, and peripheral NPY has positive stimulation effect, can co-enhance stress effect and induce vasoconstriction, and is one of the main mediators of pain generation and strengthening[12]. IL-6 and SK are widely recognized clinical pain-related factors, and the increase of their levels can directly lead to enhanced pain perception in patients[13]. In the study, early postoperative serum levels of SP, IL-6, SK and NPY levels of observation group were lower, which indicated that patients’ pain perception was lighter after single-port retroperitoneal laparoscopic surgery, and this is directly related to the lighter damage of the method to patients.

After surgery and other trauma, the levels of various related proteins in the body may differently change. Plasma albumin can transport bilirubin, dissociate fatty acid and so on, and its level is closely related to both post-traumatic complications and mortality of patients. Prealbumin is an acute phase protein that may reduce significantly after acute inflammation and trauma. Patients with severe trauma are at a high decomposition state, and accelerated decomposition of proteins in the body can cause hypalbuminemia, and result in declined endovascular colloid osmotic pressure. The change of HMGB-1 occurs relatively late, the change trend is in line with the body's inflammatory state and lasts longer, and it is regarded as a "late" inflammatory mediator[14]. HSP is a kind of non-specific protein product generated in adverse environment, and the secretion increases under the stress state[15]. In the study, early postoperative HMGB-1 and HSP72 levels of observation group were lower while albumin and prealbumin levels were higher, further indicating that single-port retroperitoneal laparoscopic surgery caused less surgical trauma, early postoperative state of decomposition of the body was lighter, and it helped patients with early postoperative rehabilitation. Upper ureteral lithotomy may cause certain damage to abdominal viscera, especially the pancreas, the main manifestations are the symptoms of acute pancreatitis, including nausea and vomiting, acute abdominal pain, etc, and laboratory tests may show temporary increase of blood and urine amylase. Single-port retroperitoneal laparoscopic surgery can effectively avoid the pancreas and other important abdominal viscera, so its damage to the other abdominal vital organs is less. In the study, blood and urine amylase levels of observation group were lower 1d after surgery, and abdominal B
ultrasound found that individual patients in control group showed pancreatic swelling, relieved echo and other symptoms, indicating that there might be intraoperative pancreatic injury, and also explaining that single-port retroperitoneal laparoscopic surgery had high security and smaller probability of pancreatic injury.

To sum up, it is concluded as follows: single-port retroperitoneal laparoscopic surgery for treatment of patients with upper ureteral calculi has positive effect on reducing surgical trauma, avoiding pancreatic trauma and other aspects, has more clinical advantages than percutaneous nephrolithotomy, and is worth popularization and application clinical practice in the future.

References