Comparative Evaluation of the Economic Costs in Patients Underwent Endoscopic Surgery on Nephrolithiasis in Dependence on Presence or Absence of Surgical Complications

Main aim of our study was to evaluate economic costs associated with the elimination of complications of endoscopic treatment of nephrolithiasis. We retrospectively analyzed medical reports of the 1027 patients (597 men - 58.1% and 430 women - 41.9%), at age (mean±SD) 38.9±15.6. There were 22 (2.1%) intraoperative complications observed in 14 (1.4%) patients. These patients got into amount of 180 (17.5%) patients developed 235 complications in the postoperative period. Fifty nine additional interventions were required for the elimination of observed complications. Postoperative hospital stay among 180 patients was 7.02±0.42 days, compared to 4.31±0.07 days in 847 patients without complications (p<0.05), duration of kidney draining 7.07±0.91 and 2.43±0.10 correspondingly (p<0.01).

Complications occurred during postoperative period in patients who underwent endoscopic surgery for nephrolithiasis prolong hospital stay up to 56%, and increases the cost of treatment up to 25%. The study of prevention of infectious and inflammatory complications, as well as other intra- and postoperative complications evidently will lead to reduction the costs of endoscopic methods of nephrolithiasis treatment.

Keywords: Urolithiasis, endoscopic interventions, complications, cost.

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Introduction

Urolithiasis is one of the most common diseases in the world. According to the literature, 70% of patients operated because of urolithiasis, get rid of multiple or staghorn stones by endoscopic method (Skolarikos, Alivizatos, and de la Rosette, 2005). Percutaneous nephrolithotomy is one of the safe and effective interventions in the treatment of urolithiasis. In the hands of an experienced endourologist this procedure becomes effective and popular one (Ritter, Krombach, and Michel, 2011). However, despite of the fact that endoscopic surgery has established itself as a safe and effective method of treatment of nephrolithiasis, as well as other operative methods, involves some risk of complications for patients, resulting in a prolongation of treatment and additional explicit costs.

Specific complications of endoscopic surgery of nephrolithiasis include bleeding, perforation of the renal pelvis, urinary leak, hydrothorax, damage of adjacent organ, acute pancreatitis, fever, sepsis with a fatal outcome (de la Rosette, Assimos, Desai et al., 2011; Michel, Trojan, and Rassweiler, 2007). The most frequent postoperative complication of endoscopic removal of stones from the urinary tract is inflammation, caused by infection, the rate of which reaches 32.7%; in some cases it is accompanied by the development of urosepsis (Michel et al., 2007; Negrete-Pulido and Gutierrez-Aceves, 2009).

Taking into account that on average 4.5% of the population in Uzbekistan suffer from nephrolithiasis (Juldashev, 1998), being at of working-able age (30-50 years), and the above condition is a common cause of temporary or permanent disability, one can realize...
an important role which play the issues related to the cost of treatment of nephrolithiasis for the economy of our country.

Based on the foresaid, the aim of our study was to evaluate the economic costs associated with the elimination of complications connected with endoscopic treatment of nephrolithiasis.

**Material and methods**

Retrospectively there were studied the medical history of 1027 patients (597 males - 58.1% and 430 women - 41.9%), mean age 38.9±15.6 (from 4 to 84 years). The stones were located only in pyelocaliceal system (PCS) in 765 (74.5%) patients, and in the ureter and PCS in 262 (25.5%) of which only in the ureter in 202 (19.7%). The average size of the stones in 1027 patients was 30.3±0.6 (3 to 150) mm, the size of the stones localized in the ureter amounted to 14.4±0.5 (3 to 55) mm. Fragmentation of stones was carried by pneumatic lithotripter.

The operations were performed through one access in 934 cases, including transurethral, through two accesses in 77 and three in 14; performance of the four approaches required in two patients. Anesthetic risk of interventions was evaluated by an objective assessment of the classification status of the patient, adopted by the American Society of Anesthesiologists.

To evaluate the surgical complications, we oriented to the criteria developed by Martin RC, et.al. (Martin, Brennan, and Jaques, 2002).

To achieve this goal we have studied the frequency of intra-and postoperative complications due to the endoscopic surgery of nephrolithiasis, performed in the period of 2008-2010 in RSCU; determined the number of additional procedures and invasive interventions performed in the postoperative period to low the complications’ growth; and carried out a comparative assessment of the economic costs associated with the elimination of complications, taking into account the period of hospital stay, duration of drainage of the renal cavity (in days) and cost of the treatment (in Uzbek sums).

Outcomes were compared using Fisher exact test, Student t test. Statistical analysis and data processing were performed using such applications as MS Office Excel 2007, StatSoft Statistica 8.0, using statistical formulas.

**Results**

We observed 22 (2.1%) serious intraoperative complications in 14 (1.4%) of 1027 patients. Eight of them were double-complicated: along with a damage of PCS and intrarenal structures there was a significant blood loss in a volume from 500 to 1130 ml (in 2 cases - damage of the “neck of calyx”, 6 - injure of intrarenal structures). In 42 (4.1%) cases a blood loss exceeded 150 ml, of them 6 (0.6%) required a blood transfusion.

In 6 patients we observed the ureter wall damage as a perforation (in 1 case - in the upper third, and in 5 in the middle third, in the places where removed stones were localized Table 1.) Thus, we found that the perforation of the ureter may take place only at crushing the stone in place. “Stone-free” were 879 (85.6%) patients. Residual stones were detected in 148 (14.4%) patients. After surgery for stone removal located only in the ureter (n=202), residual stone was found in 0.5% (1 case).

In the postoperative period, we observed 235 complications in 180 (17.5%) patients. Thus, 140 patients had one complication, 27 - two in each of them, 11 - three in each, 2 - in fours

One hundred and thirty five (13.1%) patients had a fever over 38 °C, 19 (1.8%) of them - a one-day, 116 (11.3%) two or more days. Of them in 115 (11.2%) acute pyelonephritis was diagnosed and in 1 patient acute prostatitis. Forty nine patients had hematuria, in 42
of them it was insignificant, but 7 (0.7%) had a significant blood loss, and required blood transfusion and performance of additional interventions.

**TABLE 1. FREQUENCY OF URETERAL PERFORATION DEPENDING ON STONE REMOVAL TECHNIQUE (N=262)**

<table>
<thead>
<tr>
<th>Stone removal technique</th>
<th>Number of interventions n</th>
<th>Number of ureteral perforation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;On-site&quot; lithotripsy</td>
<td>83</td>
<td>6 (7.2)</td>
</tr>
<tr>
<td>Lithoextraction (antegrade or retrograde)</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>Redeployment of stones in renal pelvis and per cutaneous litholapaxy (PNL)</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>262</td>
<td>6 (2.3)</td>
</tr>
</tbody>
</table>

The most common complication of postoperative period acute pyelonephritis was 115 (11.2%). Duration of attacks of pyelonephritis ranged from 2 to 10 days. In one patient developed severe sepsis. Of the 115 patients, 95 (82.6%) required only an additional antibacterial therapy in the hospital. But the remaining 20 (17.4%) patients for adequate treatment of pyelonephritis require the implementation of 21 additional procedures.

Thus, the analysis showed, because of postoperative complications, including pyelonephritis, were performed 59 additional procedures, 33 of them - without general anesthesia, 26 - under general anesthesia.

Twenty patients underwent PC nephrostomy, 1 - ureteroscopy, 1 - a session of hemodialysis, 4 patients - an open interventions (2 - lumbotomy due to parenchymal bleeding from the kidney, technique of embolization of branches of the renal artery in our clinic had not been established yet; 1 - resection of PUJ stricture, 1 - nephrectomy). 26 patients required replacement of nephrostomy tube, 5 - placement of the ureteral stent, 1 - medical-diagnostic fine needle aspiration biopsy (FNAB) kidney, 1 - removing of blood clots from the bladder. In one patient a severe sepsis had developed, and he was transferred to the intensive care unit.

**TABLE 2. COMPARATIVE ANALYSIS OF THE ECONOMIC COSTS ASSOCIATED WITH THE ELIMINATION OF COMPLICATIONS (M±M)**

<table>
<thead>
<tr>
<th>Index</th>
<th>Patients without complications (n=847)</th>
<th>Patients with complications (n=180)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital stay</td>
<td>4.31±0.07</td>
<td>7.02±0.42</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Duration drains of the kidney</td>
<td>2.43±0.10</td>
<td>7.07±0.91</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>The cost of treatment (Uzbek Sums)</td>
<td>586392±8491</td>
<td>727365±22977</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

According to the modified classification of postoperative complications of Clavien-Dindo (2004) (Dindo, Demartines, and Clavien, 2004), they were divided as follows: I grade - 64 (6.2%); Grade II - 111 (10.8%); IIIa grade - 33 (3.2%); IIb grade - 24 (2.3%); IVa grade - 2 (0.2%); IVb grade - 1 (0.1%); the grade of V was 0.

Referred above 14 (1.4%) patients who had intraoperative complications observed, and had also complications in the postoperative period were among the 180 patients. In the cause of our research, we analyzed the duration of hospital stay and cost of treatment of these 180 (17.5%) patients, and compared the findings with the results of 847 (82.5%) patients with uneventful intra-and postoperative period (Table 2).

Comparative analysis of the results of the studies for evaluation the economic costs associated with the elimination of complications of endoscopic treatment of nephrolithiasis showed that patients with intra-and postoperative complications are significantly longer stay in the hospital. This is due to as the additional conservative treatment and also procedures performed, which, respectively, without affecting the
moral aspects of the issue being studied, lead to a significant increase in the cost of their treatment (Table 2).

Discussion

The frequency of intra- and postoperative complications at the beginning of the introduction and development of the new endoscopic method is always higher than the routine of their use (Gonzalgo, Pavlovich, Trock, Link, Sullivan, and Su, 2005; Guillonneau, Rozet, Cathelineau, Lay, Barret, Doublet et al., 2002; Jacobs, Cho, Foster et al., 2004; Kocak, Koffron, Baker et al., 2006; Teber, Tefekli, Eskicorapci et al., 2006). In our hospital until 1997 (Giyasov, 1997) the overall incidence of intraoperative complications was 36.4%, to 2010 it decreased to 1.4%; the necessity for blood transfusions in staghorn stones decreased from 21.2% up to 2.5% in 2010.

The higher frequency of intra-and postoperative complications, the more increases the cost of patient care. And in order to reduce these costs, in our opinion, it is necessary to develop in two directions. The first - a concerted action to prevent complications. To do this, we must clearly understand what factors lead to the development of intra- and postoperative complications. Only an objective imagining the origins and nature of complications, they can be prevented. Assessment and monitoring of complications of 10 criteria, we have carried out in accordance with R.C.Martin et al. (2002). An objective assessment of the severity of complications with the additional interventions to address them, systematized according to the the modified classification of postoperative complications of Clavien-Dindo (2004), as indicated above (Dindo et al., 2004). According to Tefekli et al. (2008) 255 complications were in 237 (29.2%) patients after endoscopic surgery of nephrolithiasis. We observed 235 complications in 180 (17.5%) patients.

Our analysis of the postoperative complications showed the most frequent complication was pyelonephritis 115 (11.2%), which plays an important role in increasing hospital stay. Urosepsis was observed in 1 (0.1%). According to literature postoperative fever after PNL range 21.0 - 32.1% (Aron, Yadav, Goel et al., 2005; Dogan, Sahin, Cetinkaya, Akdogan, Ozden, Kendi, 2002; Lee, Smith, Cubelli et al., 1987; Michel et al., 2007), urosepsis 0.8-4.7% (Aron et al., 2005; Lee, Smith, Cubelli et al., 1987; Lewis and Patel, 2004; Gonzalgo, 2005; Vorrakipokatorn, Permtongchuchai, Raksamani, and Phettongkam, 2006).

The analysis of the causes of developed pyelonephritis showed that presence of a urinary tract infection before the intervention have played the role in 61.7% of patients, intraoperative complications in 21.7 %, postoperative complications in 18.3%. Accordingly, we concluded that patients with the presence of the initial urinary tract infection, intra-and postoperative complications when performing endoscopic interventions for nephrolithiasis must be classified as 'patients with an absolute risk of postoperative infectious-inflammatory complications (Giyasov and Nasyrov, 2012).

The second way are actions aimed at eliminating already developed complications. Severity, and accordingly, cause of rehabilitation period in patients with complications are directly dependent on the timeliness and adequacy of their elimination. It should also be noted that in assessing the effectiveness of measures designed to prevent and eliminate the complications of one of its most important criteria is to determine the cost of treating patients with intra-and postoperative complications in a comparative aspect.

Conclusion

A complicated postoperative period in patients after use of the endoscopic methods of treatment of nephrolithiasis, leads to increased duration of hospital stay to 56%. The cost of the treatment increases up to 25%, both due to increase of hospital stay and an additional medical therapy, and necessary additional invasive interventions. The study of prevention of infectious and inflammatory complications, as well as other intra-and
postoperative complications clearly shown to reduce the cost of endoscopic methods of treatment of nephrolithiasis.

References


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