ORIGINAL ARTICLE

Comparison of the operation time and complications between conventional and robotic-assisted laparoscopic pyeloplasty

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Abstract

Objective: To compare the different times into which the convention and robotic-assisted laparoscopic pyeloplasty can be divided. To compare the rate of complications between both procedures.

Material and methods: A retrospective study was performed of the patients diagnosed with pyeloureteral junction stenosis and treated with convention and robotic laparoscopic pyeloplasty with more than one year of follow-up. All of the interventions were recorded and visualized. The different times in which the pyeloplasty can be divided were measured. All of the peri- and post-operative complications that occurred in the patients were collected. The non-parametric tests of Kolmogorov-Smirnov and Mann-Whitney U-test for independent samples were applied using a significance level of 0.05.

Results: A total of 50 patients were validated. Thirty three were treated with convention laparoscopy and, 17 with robotic laparoscopy. The suture time, total intervention time and time of hospital stay were lower with a statistically significant difference in the robotic-assisted pyeloplasty. The robotic pyeloplasty had a lower percentage of complications (76.5% vs. 48.5%). The most frequent complications were urinary infections, in relation to the double J. Two restenoses occurred in the conventional laparoscopy and one in the robotic-assisted. The success rate was 93.9% for the conventional laparoscopy and 94.1% for the robotic-assisted one.

Conclusions: Although the success rate is similar in both procedures, the robotic pyeloplasty is a very fast procedure and has lower rates of complications than the conventional laparoscopy.

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Introduction

The pyeloureteral junction stenosis (PUJS) is the obstruction to the passage of urine from the kidney to the ureter in the area where the ureter joins the renal pelvis. In many cases, the PUJS can be asymptomatic being diagnosed during the study of other diseases; however, it may also manifest as dull ache or renoureteral colic, urinary tract infection and, thus, produce a progressive loss of renal function. The most common causes are the presence of an aberrant polar vessel, extrinsic compression, and the presence of an aperistaltic segment often associated with high implantation of the ureter into the renal pelvis.

For the resolution of this entity, we have tried several treatment options: open surgery, retrograde and antegrade endourological techniques, laparoscopic repair and, ultimately, the laparoscopic approach assisted by the da Vinci robotic system.

Our aim in this work is to compare the different operation times in which we can divide the surgical procedure and observe the differences between the conventional laparoscopic approach and the robotic Da Vinci System. We will analyze which part of the procedure is favored more by the use of the Da Vinci system and, so, we will identify which steps are improvable. We will also compare the rate of complications between both procedures.

Material and methods

Patients and variables under study

We conducted a retrospective study, analyzing patients diagnosed with PUJS and undergoing laparoscopic pyeloplasty. From January 2005 to September 2008, all the patients who were operated on for PUJS underwent conventional laparoscopic pyeloplasty (CLP), and from October 2008, all the patients operated on for PUJS underwent robotic laparoscopic pyeloplasty (RLP) with the Da Vinci System. We have selected the patients with more than 1 year of follow-up. All the interventions were recorded for later viewing and analysis. They were viewed by two urologists who have collected the different variables involved in the study.

The preoperative study in all these patients, with suspected PUJS, consists of gammagraphy to know the functional grade of the affected kidney as well as intravenous urography or UroCT to locate the stenosis and assess its length. In all cases, dismembered Anderson-Hynes pyeloplasty was performed and all the interventions were made by the same surgeon. Data such as sex, age, blood loss, cause of stenosis, complications, and hospital stay were evaluated.

The complications were classified according to the Clavien–Dindo scale. Perioperative complications were identified by studying the clinical course and nursing care registry of the patient included in their clinical history. Postoperative complications were identified in successive outpatient check-ups that have always been carried out by the same urologist.

The operative procedure was divided into four stages. The times were measured by viewing the interventions that were recorded electronically, distinguishing: peritoneal opening time (from the placement of the trocars to the identification of the ureter), time of dissection of the ureter (from the identification of the ureter to the moment prior to the section of the pelvis), spatulation time and double J catheter placement, and length of the suture. The total time (from the anesthetic induction to the end of the procedure, as recorded on the anesthesia sheet) and hospital stay were also measured.
When assessing the results, we believe that the intervention has been successful if a clinical improvement that led to the intervention (renal pain or infection control) is observed in the patient’s follow-up, and if there is no worsening of the renal function measured by renal scintigraphy or by creatinine blood test.

**Statistical method**

First, there has been an exploratory analysis of the different phases of the procedure used, which is aimed at detecting anomalous observations and violations of the assumptions of normality; prior step to see whether it is appropriate to use parametric inference techniques or if, by contrast, non-parametric inference techniques are more suitable.

We hypothesize that the populations from which data regarding operation times come follow a normal distribution, rejecting the hypothesis at a 5% significance level. To test this hypothesis, we applied the Shapiro–Wilks test to the different operation times according to each technique. The joint normality hypothesis will be rejected if at least one of the individual normality assumptions is rejected. In order not to increase the level of significance set more than 5%, the normality assumption associated to each operation time under study is rejected, (of each of the CLP or RLP techniques), if the corresponding p-value is lower than 2.5%. The rejection of the normality assumption in at least one of the samples, along with the small sample size of each data set, is indicative of the need for non-parametric inference techniques.

To make these contrasts, the Kolmogorov–Smirnov and Mann–Whitney U tests will be used for independent samples. The rejection of at least one of the tests above would indicate the existence of significant differences between the populations from which these two samples were obtained. That is, the operation time of each of the techniques is significantly different.

**Surgical technique**

A standard laparoscopic pyeloplasty technique has been followed. After anesthetic induction, the patient is placed in lateral decubitus position with trunk flexion and an inclination of 45–60° (Fig. 1). The pneumoperitoneum is performed by introducing a Verres needle placed in the subcostal anterior axillary line. The trocars are placed in the CLP as shown in Fig. 2A, and in the RLP, they are positioned as shown in Fig. 2B. In this case, we prefer to place the optic in the upper trocar to avoid conflict with the arms of the robot. Having a 12-mm trocar in the periumbilical area allows us to reposition the optic in cases of conflict with the arms of the robot or poor visualization of the upper trocar.

Once the trocars are placed and the instruments introduced, we proceed to the opening of the posterior retroperitoneum. At the level of the psoas muscle, the retroperitoneum is released medially until the gonadal vein is identified, and more medially the ureter. Then, the ureter is released and the cause of PUJS is identified. The renal pelvis is released from its anterior and posterior area, clearing the operative field of fat and adhesions, preparing it to perform the suture comfortably.
Once the ureter and pelvis are released, we proceed to the exeresis of the pyeloureteral junction about 2–3 cm. The proximal ureter spreads at least 1.5 cm.

Finally, we proceed to the double J catheter anterogradely placement. Once the ureteral catheter is placed, ureteropelvic suture is performed with a double 4-0 vicryl or monosyn suture in the CLP. In the RLP, 5–0 monosyn sutures are usually used. Once the suture is finished, a suction drainage is placed taking advantage of the hole of the lowest trocar.

The bladder catheter is removed after 24–36 h. The double J is removed after 4 weeks. Follow-up visits are made every month (coinciding with the removal of the double J), at 3, 6, and 12 months to assess the presence of complications and renal recovery. In the visit after 3 or 6 months, urinalysis and culture, blood biochemistry, and abdominal ultrasound were performed. After a year, urinalysis and culture, blood biochemistry, and scintigraphy were performed to assess renal function. In every visit, anamnesis is performed questioning the patient about possible complications.

**Results**

50 patients have been found valid for our study, 33 operated on by CLP and 17 using RLP. The demographic characteristics of the patients are shown in Table 1. All are adults, predominantly women with kidney problems. Blood loss has been insignificant and it has never had to be transfused to patients. The most common cause leading to the diagnosis of PUJS has been renal pain. Note that the follow-up is significantly lower in the RLP, which is obvious because it is a procedure that we have begun to perform for a shorter time.

The operative stay and the total intervention time (Table 2) have been collected. The overall time has been divided into four intervals and we can see how the RLP improves the time in all the intervals, and this improvement is statistically significant in the suture time, the overall time of the intervention, and the hospital stay.

In terms of complications, registered according to the Clavien–Dindo classification, a lower number is observed by RLP (76.5% vs. 48.5%). In Table 3, we can see how most of the complications are related to urinary tract infections occurred in the first month after the intervention, during the time when the patient has the double-J ureteral catheter. Only in 1 case, urinary tract infections persist; but it is a patient with neurogenic bladder due to myelomeningocele, which may explain the persistence of these symptoms after the intervention.

We detected 3 restenoses, 2 in CLP, and 1 in RLP, all treated with balloon dilation under sedation. The success rate was 93.9% for conventional laparoscopy, and 94.1% for robotic surgery.

**Discussion**

For years, the most effective method of treating PUJS has been open pyeloplasty, with a success rate of around 90–100%. Aiming to reduce the complications and discomfort caused by the approach through the lumbar area retrograde and anterograde endoscopic techniques have been developed. However, since the first laparoscopic pyeloplasty was described by Schuessler, the tendency has reversed and now the CLP has become the standard treatment. The introduction of the laparoscopic approach has enabled the surgical procedure with success rates comparable to the open surgery procedure but with the advantages of the minimally invasive surgery: less pain,
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Table 3 Conventional laparoscopic pyeloplasty (CLP) and robotic (RLP) surgical complications according to the Clavien-Dindo classification.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>CLP</th>
<th>RLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>No complications</td>
<td></td>
<td>16 (48.5)</td>
<td>13 (76.5)</td>
</tr>
<tr>
<td>Grade I</td>
<td></td>
<td>1 (3.1)</td>
<td>0</td>
</tr>
<tr>
<td>Grade II</td>
<td>10 urinary infection (8 during the first month)</td>
<td>10 (30.3)</td>
<td>3 (17.6)</td>
</tr>
<tr>
<td>Grade IIIa</td>
<td>1 ascended double J removed under local anesthesia</td>
<td>5 (15.2)</td>
<td></td>
</tr>
<tr>
<td>Grade IIIb</td>
<td>1 ascended double J catheter placement</td>
<td>1 (3)</td>
<td>0</td>
</tr>
</tbody>
</table>

earlier physical recovery, shorter hospital stay. However, not all have been advantages and the CLP requires more training as performing intracorporeal suture represents further complexity. These problems are given by the limitation of two-dimensional view, the limitation of movement by the placement of the trocars, laparoscopic instruments being thicker than those of open surgery, and the ureter and pelvis being thin and easily tear-structures. Therefore, this technique is partially limited to centers with great experience or high volume of patients.

The introduction of RLP has helped the performance of the laparoscopic procedure, since it provides a three-dimensional vision, it reduces the surgeon’s intentional tremor, and it uses instruments finer than laparoscopy and articulated, with 7 degrees of freedom. Therefore, the performance of intra-corporeal suturing more safely and using sutures finer than 5 or 6/0 is favored. However, not all are advantages in RLP. This approach provides no tactile sensation, it has significantly increased the costs and it is a priori a longer procedure.

In both procedures, there are few major complications. Most occur in the first weeks and are mainly related to urinary tract infection with double-J catheter placement.

The increase in double-J catheter occurred in the first cases. When the double-J catheter fails to get into the bladder properly, we proceed to fill the bladder with saline solution enabling the bladder walls to separate and the guide to go through the bladder and coil; likewise, we try to use long enough catheters. A comparison of the complications is difficult to perform with other authors especially as it can be strict when it comes to identifying them. Thus, in major complications, there are no differences with other studies; although globally we have a higher rate of minor complications, possibly because of having been thorough in their identification and registration.

Regarding the operation times, the RLP improves the time in all the stages in which the intervention has been divided. There are two possible explanations, the first one that the surgeon and his surgical team have achieved the learning curve after making over 100 robotic prostatectomies and they only had to refine the placement of the trocars; and the second one that when the RLP was started to be performed, the same team had made more than 50 CLP in which the learning curve had been higher and problems like port placement, the placement of double-J, and the intracorporeal suture technique had been solved. The times that have been reduced the most are the operation time of the ureteropelvic suture, and the overall time of the intervention. In the opening of the retroperitoneum and in the dissection of the ureter and pelvis, we believe that the RLP does not provide benefits to the CLP, as with the CLP we have a wider range of movements, and this dissection does not need to be so meticulous. In other works, the operation times of the CLP and the RLP are similar, although in general, there is a decrease of 10 min in the RLP.

Conclusions

The PLC is still a procedure that must be considered the standard for the treatment of the PUJS. It is a procedure with scarce late complications, similar to open surgery. The RLP has improved the deficiencies that the PLC had, such as the intracorporeal suturing, and it enables the surgeon to perform it in a safer and faster way.

Conflict of interest

The authors declare that they have no conflict of interest.

References