



## ORIGINAL ARTICLE

### Laparoscopic nephrectomy in children

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#### KEYWORDS

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#### Abstract

**Introduction:** Laparoscopic nephrectomy in children, not as in the adult population, has evolved more slowly due to the misleading concept that children require small incisions and recover faster. The aim of this article is to present our experience in laparoscopic renal surgery in a pediatric population.

**Material and methods:** We checked the clinical records of children that were subjected to laparoscopic renal surgery at our institution between May 1993 and September 2010. We recorded the data prospectively and analyzed it retrospectively. The variables we studied were surgical indication, age, sex, procedure and approach, surgery time, hospital stay, intraoperative bleeding, perioperative complications, conversion to open surgery, reintervention and blood transfusion rates.

**Results:** Between May 1993 and September 2010, we operated a total of 72 patients, 45 nephrectomies (62.5%), 13 nephroureterectomies (18%) and 14 heminephrectomies (19.4%). The mean age was 68 months (range 3-168). The mean surgery time was 80.4 min. (range: 25-270 min.) with an estimated mean blood loss of 37.5 ml (range: 0-1.000 ml). There were 3 (4.1%) conversions to open surgery. One was due to intraoperative bleeding and the other two were secondary to a difficult dissection due to a history of prior renal surgical interventions. The mean hospital stay was 3.17 days (range: 1-30 days) and there were 7 (9.72%) postoperative complications. There were no deaths.

**Conclusions:** We consider the laparoscopic approach for renal surgery in pediatric patients to be a feasible, safe and effective procedure that must be considered as the first option for the treatment of benign pathology in this population group.

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**PALABRAS CLAVE**

Riñón;  
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**Nefrectomía laparoscópica en niños****Resumen**

**Introducción:** La nefrectomía laparoscópica en niños, a diferencia de la población adulta, ha tenido una evolución más lenta debido al erróneo concepto de que los niños requieren incisiones pequeñas y se recuperan con mayor rapidez. El objetivo de este artículo es presentar nuestra experiencia en cirugía renal laparoscópica en una población pediátrica.

**Material y métodos:** Se revisaron las historias clínicas de los niños que fueron sometidos a cirugía renal laparoscópica en nuestra institución entre mayo de 1993 y septiembre de 2010. Los datos fueron registrados prospectivamente y analizados de forma retrospectiva. Las variables analizadas fueron la indicación quirúrgica, edad, sexo, procedimiento y abordaje, tiempo de quirófano, estancia hospitalaria, sangrado intraoperatorio, complicaciones perioperatorias, conversión a cirugía abierta, reintervención y tasas de transfusión de sangre.

**Resultados:** Entre mayo de 1993 y septiembre de 2010 un total de 72 pacientes fueron operados; se practicaron 45 nefrectomías (62,5%), 13 nefroureterectomías (18%) y 14 heminefrectomías (19,4%). La edad media fue de 68 meses (rango: 3-168). El tiempo medio operatorio (OR) fue de 80,4 minutos (rango: 25-270 min) con una pérdida estimada sanguínea promedio de 37,5 ml (rango: 0-1.000 ml). Hubo tres (4,1%) conversiones a cirugía abierta. Una fue debido a un sangrado intraoperatorio y las otras dos secundarias a una difícil disección debido a presentar cirugías renales previas. La estancia media hospitalaria fue de 3,17 días (rango: 1-30 días) y hubo 7 (9,72%) complicaciones postoperatorias. No hubo mortalidad.

**Conclusiones:** Consideramos que el abordaje laparoscópico para la cirugía renal en pacientes pediátricos es un procedimiento factible, seguro y eficaz que debe ser considerado como la primera opción para el tratamiento de la patología benigna en este grupo de población.

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**Introduction**

During the last decade, laparoscopic techniques for renal surgery have been introduced into the pediatric population. Since the first pediatric laparoscopic nephrectomy performed by Kavoussi and Koyle in 1992, several series have shown that the laparoscopic approach, whether transperitoneal or retroperitoneal for renal surgery are safe and effective procedures, and are a good alternative to open approaches procedures.<sup>1</sup>

However, the fact that younger children require smaller incisions and heal relatively quickly, calls into question the benefits of minimally invasive surgery. The aim of this article is to present our experience in laparoscopic renal surgery in a pediatric population.

**Material and methods**

We reviewed the medical records of all the children who underwent laparoscopic renal surgery at our institution between May 1993 and September 2010. We collected data prospectively and analyzed it retrospectively. The variables we analyzed were indication for surgery, age, sex, procedure and approach, operative time (OT), hospital stay, blood loss, perioperative complications, conversion to open surgery, reoperation and blood transfusion rates.

**Surgical technique**

We placed the child in flank position without lumbar extension and without changing the angle of the surgical table (fig. 1). We performed the pneumoperitoneum using a Veress needle at 12mm Hg and we only placed three working trocars. To the left, we placed a 5mm umbilical trocar for optics, another 5mm in the left lower quadrant and the third 3mm subcostal. To approach the right kidney, as opposed to the contralateral, we placed a 5mm trocar subcostal and another 3mm in the right iliac fossa (fig. 2). A 5mm working trocar is necessary even in young children, as there are no clippers with a smaller diameter. In children over 3 years all the ports we use are 5mm. The rest of the procedure is the same as a standard nephrectomy in adults. In the case of heminephrectomies, we locate the ureter of the upper system, which, after identifying the lower pole vascular pedicle to be preserved, we section and pulled behind the pedicle. This pulling of the ureter allows identifying and clipping the upper pedicle. We have not performed open surgery at our unit since we introduced the laparoscopic approach, regardless of the child's age.

**Results**

In the established period, we operated 72 children, of whom 31 were male and 41 female with a mean age of 4



**Figure 1** Position of 3-month old child for left renal surgery.



**Figure 2** The same child with working ports for left heminephrectomy. A 5mm umbilical (optical) trocar, another 5mm trocar in left iliac fossa, and subcostal 3mm trocar.

years 2 months (range 28 days-14 years). The most frequent indications were multicystic kidney in 25 cases (34.7%), reflux nephropathy in 17 cases (23.6%), ureteropelvic junction obstruction in 6 cases (8.3%) and ureterocele in 5 cases (6.9 %). We performed 45 nephrectomies (62.5%), 13 nephroureterectomies (18%) and 14 heminephrectomies (19.4%). Seventy-one procedures (98.6%) were using a transperitoneal approach and we only performed one nephroureterectomy (1.38%) applying a retroperitoneal approach.

The average operative time (OT) was 80.4 minutes (range 25-270 min) with a mean intraoperative blood loss of 37.5 ml (range: 0-1,000 ml). Three (4.1%) patients required conversion to open surgery, all initially operated using the transperitoneal approach. One of these was due to intraoperative bleeding in a female patient with 3 months of ureteropelvic junction obstruction (UPJ obstruction) associated with chronic pyelonephritis. The other two conversions were secondary to a difficult dissection due to adhesions caused by previous renal surgery. All these

**Table 1** Demographic and surgical data

<i>Number of patients</i>	72
<i>Mean age (months)</i>	68 (range: 2-168)
<i>Sex Male/Female</i>	2/3
<b>Procedure</b>	
Nephrectomy	45 (62.5%)
Nephroureterectomy	13 (18%)
Heminephrectomy	14 (19.4%)
<b>Approach</b>	
Transperitoneal	71 (98.6%)
Retroperitoneal	1 (1.4%)
<i>Operative Time (minutes)</i>	80.4 (range: 25-270)
<i>Blood loss (ml)</i>	37.5 (range: 0-1000)
<i>Conversion Rate</i>	3 (4.1%)
<i>Transfusion Rate</i>	1 (1.38%)
<i>Mean hospital stay (days)</i>	3.17 (range: 1-30)
<i>Complication rate</i>	7 (9.7%)
<i>Serious complication</i>	1 (1.38%)
<i>Minor complication</i>	6 (8.3%)

cases occurred during the initial learning curve. The mean hospital stay was 3.17 days (range: 1-30 days) and there were 7 (9.72%) postoperative complications, 6 minor complications and one serious. The latter was postoperative bleeding in a 7-month old male patient with a multicystic left kidney, which required another operation. There was no mortality in this series (table 1).

## Discussion

In the last decade laparoscopic renal surgery has gained popularity among pediatric urologists. Since Kavoussi and Koyle performed the first laparoscopic nephrectomy performed on a child in 1992, many series have shown the advantages of this approach over open surgery. Although laparoscopic nephrectomy is well established and considered by many authors as the golden rule in adult renal surgery,<sup>2</sup> there are still questions regarding its indications and real benefits in the pediatric population. The fact that younger children require smaller incisions that heal relatively quickly with minimal scarring, questions the benefits of this approach, which arise at the expense of increased operative times, higher costs and a long learning curve.<sup>1</sup> However, older children and teenagers benefit from better aesthetics, faster recovery times and less analgesia.<sup>1,3-5</sup>

Laparoscopic simple nephrectomy is considered by many authors as the standard of care;<sup>2</sup> it offers advantages such as less postoperative pain, reduced wound complications, less surgical scars, shorter hospital stay and earlier return to normal activities such as eating, bowel movement or school.<sup>6</sup> Hamilton et al.<sup>2</sup> compared laparoscopic nephrectomy to open surgery in the pediatric population and provided further evidence of the efficacy and safety of laparoscopic

nephrectomy in this population. Ku et al.<sup>7</sup> compared 13 conventional surgical procedures with 10 laparoscopic nephrectomies and nephroureterectomies in the pediatric group. The mean OT, blood loss and complication rates were not statistically significant. However, hospital stay was 2.5 versus 4 days ( $p = 0.018$ ), statistically significant in favor of the laparoscopic group. These results are comparable with data from our series with regard to the median OT, blood loss and hospital stay.

On the other hand, laparoscopic partial nephrectomy, compared with simple nephrectomy is technically more complex and more demanding because of the risk of bleeding, urinary fistula and vascular compromise of the remaining renal tissue,<sup>1,3</sup> which makes it mandatory to have the appropriate instruments and advanced skills in laparoscopy. However, this approach is entirely feasible and safe. Robinson et al.<sup>8</sup> compared laparoscopic partial nephrectomy to open nephrectomy finding that the former approach offered a shorter hospital stay, less analgesic requirement and better cosmetic results. Notwithstanding, open procedures were quicker and less expensive. El Ghoneimi et al.<sup>9</sup> found no difference in the mean OT, but demonstrated a statistically significant difference in hospital stay (1.4 versus 3.9) in favor of laparoscopy. Piagge et al. reported 14 transperitoneal partial nephrectomies and compared them with 20 open procedures. The average OT for the laparoscopic procedure was 180 minutes, while the average OT for open surgery was 115 minutes. The average hospital stay for the laparoscopic procedure was two days, while for the open procedure it was three days.<sup>10</sup>

In the case of nephroureterectomy, the advantages of the laparoscopic approach over open surgery are: a good exposure of the anatomy and blood vessels without the need to mobilize the remaining renal portion and without groin incision to extract the ureter.

El Ghoneimi<sup>9</sup> reported 15 laparoscopic retroperitoneal nephroureterectomies, which he compared with 13 open procedures. Mean operative time (OT) for the open procedure was 146 minutes versus 152 minutes for laparoscopy. The average hospital stay was 3.9 days for the open approach and 1.4 days for the laparoscopic group ( $p < 0.001$ ).

Many series have demonstrated the safety and effectiveness of both the transperitoneal or retroperitoneal approaches.<sup>4,5</sup> The retroperitoneal approach is more akin to open surgery and offers quick and easy exposure of the renal pedicle, minimizing the possibility of damage to polar vessels. Moreover, complications such as hematomas or urinomas are limited to the retroperitoneum.<sup>1,4</sup> This approach is preferred in patients older than 12 months who required an upper polar heminephrectomy with partial ureterectomy.<sup>4</sup> The main disadvantage of this approach is the limited working space, which hinders the visualization of the hilum and the distal ureter.

The transperitoneal approach offers clear anatomical landmarks, excellent exposure of the kidney and its vessels due to a larger workspace and is the best choice when it is necessary to totally remove the ureter.<sup>1,4</sup> A disadvantage of this approach is the difficult dissection and identification of polar vessels without actually damaging major vessels.

Castellan et al.<sup>4</sup> published a comparative study between 32 transperitoneal heminephrectomies and 16 retroperitoneal heminephrectomies. The mean OT for the retroperitoneal group was 133 minutes and 125 minutes for the transperitoneal approach. There were three complications (9%) in the transperitoneal group, none of them directly related to the approach. There were two complications in the retroperitoneal group, a urine leak that resolved spontaneously, and a urinoma that was managed conservatively. The mean hospital stay was two days in both groups. It was concluded that the rate of complications is related to the limited surgical space, especially in younger patients, therefore it depends on the patient's age rather than on the surgical approach. It is for this reason that the transperitoneal approach is preferred in patients younger than 12 months, especially those with large kidneys or when a total ureterectomy is necessary. According to the foregoing, it seems that both approaches have their advantages, and apparently all speculation on the benefits of one over the other is premature until a formal comparative study is carried out. It does seem however, that there is no significant advantage between these two techniques.<sup>10</sup>

From our point of view, there is no formal contraindication for laparoscopic renal surgery in children. Initially in the series, the greatest difficulty was to find the appropriate instruments for use in children, and we often had to resort to adult instruments with a 10mm lens. Today, our unit possesses laparoscopic instruments for neonatal surgery and pediatric surgery for any age.

In summary, although the indications for laparoscopic renal surgery in the pediatric population are limited, they are expanding, and many authors consider this procedure as the standard of care. Safety and efficacy have been demonstrated and the comparison with the open procedure has revealed clear advantages for the laparoscopic approach. We believe that, according to our results, laparoscopic surgery for pediatric transperitoneal or retroperitoneal renal surgery is feasible, safe and

effective and should be considered as the first choice of treatment of benign diseases in this population group.

### Conflict of interest

The authors declare that they have no conflict of interest.

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