

## ORIGINAL ARTICLES

## Comparative Evaluation of Laparoscopic Versus Open Nephrectomy in Children

*P Sekaran, GA MacKinlay, J Lam***Correspondence to:**

Dr Prabhu Sekaran, Department of Paediatric Surgery, Royal Hospital for Sick Children, Sciennes Road, Edinburgh, EH9 1LF

Tel 0131 5360662

Fax 0131 5360665

Email prabhu\_sekaran@hotmail.com

**ABSTRACT****Background and Aims**

To assess the benefits of laparoscopic nephrectomy in children as compared to open surgery and to ascertain whether or not the retroperitoneal technique offers any surgical advantage over the transperitoneal approach.

**Methods and Results**

This study gathered retrospective data on a consecutive series of 51 paediatric patients comparing; operative time, length of hospital stay and analgesic requirement. Results show that when laparoscopic surgery is compared with the open technique it took 25 mins longer to perform, there was a shorter post operative stay by 2.5 days, and a 50% reduction in morphine use. Patients who had the retroperitoneal technique were discharged from hospital within one day.

**Conclusions**

Compared to previous studies, the findings in this study suggest that there are distinct benefits in laparoscopy for children. There is some evidence in favour of the retroperitoneal technique. Patients are in hospital for shorter periods and need less analgesia.

**Introduction**

Whilst laparoscopic nephrectomy is widely performed in adults, the advantages of laparoscopy compared to traditional open surgery in the paediatric population have not been fully assessed.

The literature on paediatric nephrectomies has been limited to case reports and case series, with only one previous study comparing open to laparoscopic nephrectomy.<sup>1</sup> It is widely believed that therapeutic laparoscopy in children is technically demanding, requiring extensive surgical experience, with the operative procedure taking too long and being expensive.<sup>2</sup> Many paediatric surgeons believe that there are very few conditions which merit laparoscopic intervention.

This study aims to determine the usefulness of laparoscopic nephrectomy compared to traditional open surgery and to compare the transperitoneal technique with the retroperitoneal technique.

**Methods**

Using a medical audit database, all consecutive nephrectomies performed between January 1996 and September 2004 by a single surgeon were reviewed. From

this initial group all nephrectomies undertaken due to neoplastic disease and xanthogranulomatous pyelonephritis were excluded. This left a group of 51 paediatric patients who had undergone nephrectomies. Twenty two had had open procedures, 14 had undergone transperitoneal nephrectomy and 12 retroperitoneal nephrectomy. There were three conversions (this data was excluded in analysis).

The operative method used in this centre for transperitoneal laparoscopic nephrectomy involves ports being placed at the umbilicus and in the upper quadrant and iliac fossa. A short paracolic incision of the peritoneum is made to mobilise the kidney, the renal vessels are exposed and divided between two proximal and one distal clip in turn. The ureter is divided at an appropriate level and ligated. The kidney is then dissected free of the respective adrenal gland and the surrounding peritoneum and is delivered through the umbilicus.

For retroperitoneal nephrectomy the patient is placed in the lateral position and a 1cm incision is made below the tip of the 12th rib. By blunt dissection a plane is developed into the perirenal retroperitoneal space. The retroperitoneal space is initially established by a balloon filled with air and then subsequently by a CO<sub>2</sub> insufflator attached to an initial port. Two secondary trocars are then placed under vision, anteriorly and posteriorly to the first port. The procedure is subsequently as for transperitoneal laparoscopic nephrectomy. Open nephrectomy is via the standard transperitoneal approach.

This study gathered retrospective data on all patients comparing operative time, length of post-operative stay, analgesic use in open nephrectomy and endoscopic nephrectomy. The quantitative data was then analysed using the unpaired t-test, with  $p < 0.05$  considered statistically significant.

**Results**

Open nephrectomies were performed in 22 children, median age 3.75yrs (range 0.5-17yrs); six were performed

for multi cystic dysplastic kidney disease (MCDK), twelve for vesicoureteric reflux (VUR) and four for obstructive nephropathy (OBS).

Endoscopic nephrectomies were performed in 26 children, median age 6.5yrs (range 0.5-13.5yrs), transperitoneal: one for MCDK, nine for VUR, four for OBS; retroperitoneal: four for MCDK, five for VUR and three for OBS. The patient demographics in this study are shown in Table I. Tables II and III show the results of this study.

The mean operative times to complete the procedures were as follows.

- Open surgery - 62 minutes
- Endoscopic surgery - 87 minutes
- Transperitoneal - 96 minutes
- Retroperitoneal - 75 minutes.

The mean post operative hospital stay, was 4.0 days for open surgery, 1.5 days for laparoscopic, 2.0 days for the transperitoneal group and 1.0 day for the retroperitoneal group.

Post-operative analgesic use was compared quantitatively in the endoscopic and open groups by checking the amount of morphine used and the number of epidurals. The morphine dose was standardised in all cases according to the patients' weights. For endoscopic surgery the mean dose of morphine administered post operatively was 276µg/kg compared to 583µg/kg for open surgery, a reduction of approximately 50%. When the two endoscopic techniques were compared, the mean morphine required for the transperitoneal method was 312µg/kg and 235µg/kg for the retroperitoneal technique.

Epidural use post operatively was determined by the anaesthetist. This was found to be three times per patient in the open group. Epidurals were not used in any of the patients who had laparoscopy. This study did not attempt to quantify the amount of oral analgesia i.e. paracetamol or dihydrocodeine used by each individual patient. For all patients in this study there were no major complications during surgery.

Three transperitoneal nephrectomy patients required conversions due to equipment failure, bleeding and obesity associated with severe kyphoscoliosis. The mean operative time for the conversions was 120 minutes. The mean postoperative stay was 4 days. Mean morphine required was 640µg/kg. As there were only three patients who

**Table I Patient Demographics Showing the Range of Variables**

	Age Range (yrs)	Weight Range (Kgs)	Range of Op Time (mins)	Range of PO stay (days)	Range of MPO (µg/kg)
<b>OPEN (22)</b>	0.5-17	3.75-63.4	30-105	2-7	0-1404
<b>LAP (14)</b>	0.5-11	4.8-45.2	55-135	1-4	0-580
<b>RETRO (12)</b>	1-13.5	10.5-61.8	45-165	1-2	0-849

Abbreviations: Transperitoneal laparoscopy (LAP), Retroperitoneal Laparoscopy (RETRO), Operative Time (Op time), Postoperative Stay (PO stay), Analgesia: Morphine Post Operatively (MPO).

**Table II Comparison of Mean Values for Open with Endoscopic Nephrectomy**

	Open (22)	Endoscopic (26)	p Value
<b>Age (yrs)</b>	5.0	7.0	Not significant
<b>Weight (kgs)</b>	20.4	26.2	Not significant
<b>Op. time (mins)</b>	62	87	p < 0.05
<b>PO stay (days)</b>	4.0	1.5	p < 0.05
<b>MPO (µg/kg)</b>	583	276	p < 0.05

**Table III Comparison of Mean Values of Transperitoneal versus Retroperitoneal Nephrectomy**

	Transperitoneal (14)	Retroperitoneal (12)	p Value
<b>Age (yrs)</b>	9.0	5.0	Not significant
<b>Weight (kgs)</b>	27.9	24.2	Not significant
<b>Op. time (mins)</b>	96	75	Not significant
<b>PO stay (days)</b>	2.0	1.0	p < 0.05
<b>MPO µg/kg</b>	312	235	Not significant

needed conversions and as this study is specifically looking at the comparison between open and laparoscopic surgery, and the comparison between the transperitoneal technique and the retroperitoneal technique, the data for conversions was not analysed further.

## Discussion

Laparoscopic nephrectomy was originally described by Clayman and colleagues in 1991.<sup>3</sup> In adults it is widely accepted as an effective surgical intervention because it is as quick as open surgery in experienced hands. There are also fewer post operative complications and a shorter recovery period.<sup>4</sup>

The initial report of paediatric laparoscopic nephrectomy was published in 1992.<sup>5</sup> Since then there has been a series of reports of laparoscopic renal surgery in children.<sup>2,6,7,8,9,10,11,12</sup> There is little evidence that this technique is more beneficial and cost effective when compared to open surgery. To our knowledge there has been one retrospective study comparing laparoscopic nephrectomy with open surgery involving 20 paediatric patients.<sup>1</sup>

It is believed by some surgeons that children recover quickly so there is no need for the technically demanding laparoscopy. Open surgery may, in their opinion, be preferable. Internal injury has also been considered to be a potential problem with laparoscopy. This problem arises because the peritoneum is a small space therefore the risk of potential trauma is exaggerated.

This study has shown that the operative time in the laparoscopic cases is significantly longer than traditional open surgery (by approximately 25 minutes). This disadvantage however is compensated for by the fact that children having a laparoscopic nephrectomy leave hospital on average 2.5 days earlier and post-operative morphine use is reduced by 50%, with no epidurals being required.

Analysis of the data of the two endoscopic techniques shows that retroperitoneal laparoscopy was quicker by 20 minutes to perform and that patients left hospital within a day. The retroperitoneal procedures were taken in the latter half of the study series, when a shorter post operative stay was the norm. Therefore, it may be the case that the children who were discharged within 24 hours reflect a change in attitude towards length of post operative stay rather than any surgical advantage of the retroperitoneal technique. It is important to note that retroperitoneal surgery is not a substitute for transperitoneal surgery as large kidneys may be easier to mobilise transperitoneally.

As with any new technique the surgeons are continually learning, and developing their operative techniques. As these data have incorporated all laparoscopic nephrectomies meeting the study criteria, all the initial procedures have been used in the quantitative analysis. Including all the initial procedures will bias the results, as at first, the operations took longer, because the surgeons had not yet mastered the technique. Currently in this centre, laparoscopic nephrectomies are quicker than via the open technique with the surgeon preferring to do laparoscopic procedures.

There has been a previous study by Hamilton et al comparing open nephrectomies to laparoscopic nephrectomies in children.<sup>1</sup> The numbers were small in that study with 10 children undergoing laparoscopy and 10 having open surgery. This study found that the mean operative time was 175.6 versus 120.2 minutes ( $p = 0.01$ ) and mean hospital stay was 22.5 versus 41.3 hours ( $p = 0.03$ ) in the laparoscopic and open nephrectomy

groups respectively. They did not quantitatively assess the analgesic use as is the case in this study. Their results show that laparoscopy is a long operation but that the benefit is that children may be in hospital for a shorter period of time. Other studies have shown that nephrectomy may be performed for benign disease in children using laparoscopy resulting in minimal morbidity, minimal postoperative discomfort, improved cosmesis and a short hospital stay.<sup>1,3</sup> There has been a report of children who had undergone retroperitoneal laparoscopy achieving full activity within a week with patient satisfaction reported as being excellent.<sup>2</sup>

Whether laparoscopic nephrectomy is useful in small children or infants, has not been fully ascertained. In this study there were only two children under the age of 1 year who underwent a laparoscopic procedure (5 months and 11 months). Operative length was 80 and 55 minutes, post operative stay was four days and one day and post operative morphine requirement was 430 and 0 mg/kg respectively. These data which could not be statistically analysed show that it is possible to perform a laparoscopic nephrectomy even in infants.

## Conclusion

The findings in this study show that patients are in hospital for shorter periods and that they require less analgesia after having laparoscopic nephrectomy. With the retroperitoneal technique patients were in hospital for only one day.

## Acknowledgements

The authors would like to thank Mrs Jean Walker for help in obtaining the case notes.

## REFERENCES

- Hamilton BD, Gatti JM, Cartwright PC et al. Comparison of laparoscopic versus open nephrectomy in the pediatric population. *J Urol* 2000; 163: 937–9
- Kobashi KC, Chamberlain DA, Rajpoot D et al. Retroperitoneal laparoscopic nephrectomy in children. *J Urol* 1998; 160: 1142–4
- Clayman RV, Kavoussi LR, Soper NJ et al. Laparoscopic nephrectomy (letter). *N Engl J Med* 1991; 324: 1370–1
- Rassweiler J, Frede T, Henkel TO, et al. Nephrectomy: a comparative study between the transperitoneal and retroperitoneal laparoscopic versus the open approach. *Eur Urol* 1998; 33: 489–96
- Ehrlich RM, Gershman A and Fuchs G. Laparoscopic nephrectomy in a child; expanding horizons for laparoscopy in paediatric urology. *J Endourology* 1992; 6: 463
- Figenshau RS, Clayman RV, Kerbl K et al. Laparoscopic nephroureterectomy in the child; initial case report. *J Urol* 1994; 151: 740–1
- Koyle MA, Woo HH, Kavoussi LR. Laparoscopic nephrectomy in the first year of life. *J Pediatr Surg* 1993; 28: 693–5
- Ehrlich RM, Gershman A, Fuchs G. Laparoscopic renal surgery in children. *J Urol* 1994; 151: 735–9
- Diamond DA, Price HM, McDougall EM et al. Retroperitoneal laparoscopic nephrectomy in children. *J Urol* 1995; 153: 1966–8
- Janetschek G, Seibold J, Radmayr C et al. Laparoscopic heminephroureterectomy in paediatric patients. *J Urol* 1997; 158: 1928–30
- Davies BW, Najmaldin AS. Transperitoneal laparoscopic nephrectomy in children. *J Endourol* 1998; 12: 437–40
- El-Ghoneimi A, Valla JS, Teyaert H et al. Laparoscopic renal surgery via a retroperitoneal approach in children. *J Urol* 1998; 160: 1138–41
- Yao D, Poppas DP. A clinical series of laparoscopic nephrectomy, nephroureterectomy and heminephroureterectomy in the pediatric population. *J Urol* 2000; 163: 1531–5