The development of laparoscopic surgical skills in pediatric urologists: longterm outcome of a mentorship-training model

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Introduction and objectives: *We previously reported the successful attainment of laparoscopic skills in a group of practicing pediatric urologists without previous formal laparoscopic training. During the mentorship period, the four urologists (trainees A, B, C, and D) performed a number of renal retroperitoneal laparoscopic procedures (RRLP) under the tutelage of an expert mentor. Specifically, trainee A performed or assisted in 8 RRLP while trainees B, C, and D performed/assisted in 10, 7, or 18 RRLP, respectively. Herein we assessed the outcome of this training program and practice pattern of this same group of urologists.*

Methods: *Following the completion of the mentorship period, we reviewed the outcomes of all of the consecutive RRLP performed from September 2001 to March 2005 with respect to operative time, conversion rate, perioperative complications and length of hospital stay (LOS). Furthermore, we attempted to correlate the number of procedures each surgeon performed both during and subsequent to the mentorship period.*

Results: *Fifty-two ablative RRLP including nephrectomy (n=38), partial nephrectomy (n=12), or synchronous bilateral nephrectomy (n=2), were performed on 50 patients (19 males, 31 females) with a mean age of 5.5 years (range 4 months-14 years). Trainee A performed 16/40 procedures, trainees B and C each performed 2/40, while trainee D performed 20/40 procedures. Mean operative time was 2.4 hours (range 1.5-6.3 hours). Five patients required open conversion due to inability to obtain retroperitoneal access (n=3) or failure to progress (n=2). Two patients (one nephrectomy, one partial nephrectomy) developed retroperitoneal urinomas requiring temporary urinary diversion. There were no other perioperative complications and mean LOS was 1.2 days (range 1-4 days). More advanced reconstructive procedures have since been performed with the aid of laparoscopic exposure; trainee D has thus far successfully performed 12 laparoscopically assisted pyeloplasties.*

Conclusions: *This series demonstrates the effectiveness of the mentorship-training model to introduce RRLP to a pediatric urology training program. It is evident that the post-mentorship practice is affected by the number of cases initially performed during the training period. The development of an "expert" laparoscopist is dependent not only on initial training experience, but continued education through ongoing case exposure.*

Key Words: laparoscopy, pediatric, outcome, mentorship-training

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Introduction

Minimally invasive surgery continues to become increasingly popular throughout various surgical subspecialties. Within urology, some laparoscopic

procedures have now become the gold standard as they offer similar or even superior outcomes to open techniques.[1] Extrapolation of laparoscopy to pediatric patients has occurred at a somewhat decreased rate due to the fact that the vast majority of practicing pediatric urologists have little or no previous formal training in laparoscopy as well as the decreased number of potential laparoscopic cases in children and the reduced recovery time inherent in most children following open surgery. However, recent reports have demonstrated the utility and feasibility of laparoscopy within pediatric urology to decrease post-operative analgesic requirements, hospital stay, as well as convalescence.[2-4]

We previously reported the successful attainment of laparoscopic surgical skills in a group of practicing pediatric urologists whom had no previous formal laparoscopic training.[5] At the conclusion of the mentorship period, all planned to incorporate pediatric laparoscopy into their routine practice for ablative renal procedures. The objectives of this study were to assess the long-term outcome of this training modality as well as the retention of laparoscopic skills and practice pattern of this same group of urologists following the mentorship period.

Methods

Previously, four full-time practicing pediatric urologists, none of whom had any previous formal laparoscopic training, underwent an intensive 10-month mentorship-based laparoscopy-training program at our center. Briefly, the program was designed to introduce and educate the group regarding advanced laparoscopic retroperitoneal renal surgery and consisted of didactic lectures, inanimate pelvic trainers, porcine models, and mentored live surgery. All trainees were practicing at the Hospital for Sick Children at the time of the training period, and therefore each was exposed to the expert mentor on a day to day basis. Each trainee experienced all stages of the mentorship program including initial education regarding the basic principles of laparoscopy, laparoscopic instrumentation and the physiologic changes associated with laparoscopy, with subsequent progression to practical issues such as the appropriate selection of patients, proper positioning and trocar placement, as well as the correct selection of instruments. Finally, each trainee observed, assisted and performed a number of RRLP under the direct guidance of the expert mentor.

Following the completion of the mentorship period, all of the consecutive RRLP performed by each of the four pediatric urologists at the Hospital for Sick Children were evaluated with respect to their operative time, conversion rate, incidence of perioperative complications and length of hospital stay. Correlation was made between the number of RRLP performed by each urologist (trainees A, B, C, and D) and their previous experience during the mentorship period. Operative times were defined as actual "skin-to-skin" procedural times.

Results

Over two and half years have elapsed since the completion of the mentorship-training period. Since that time, each trainee has performed a number of RRLP. In total, 52 ablative procedures including nephrectomy (n=38), partial nephrectomy (n=12), or synchronous bilateral nephrectomy (n=2), were undertaken on 50 patients (19 males, 31 females) with a mean age of 5.5 years (range 4 months-14 years). Indications for nephrectomy included the presence of a multicystic dysplastic kidney in 10, a non-functioning or atrophic kidney in 22, and an atrophic or poorly functioning kidney in the presence of renal vascular hypertension in 6. The mean operative time for nephrectomy was 2.35 hours (range 1.6-5.0 hours). Figure 1 shows consecutive operative times for all of the laparoscopic nephrectomies.

All of the patients who underwent partial nephrectomy were previously diagnosed with a non-functioning upper (n=11) or lower (n=1) pole moiety of a duplicated collecting system. The mean operative time was 2.75 hours (range 1.8-3.75 hours) for partial nephrectomy, Figure 2.

Five patients required open conversion early following the training period either due to inability to obtain retroperitoneal access (n=3) or failure to progress (n=2). These occurred during the first 6 months following the completion of the training period. Two patients (one who underwent nephrectomy and one partial nephrectomy) developed retroperitoneal urinomas secondary to refluxing ureteral stumps requiring temporary urinary diversion. Both resolved following a short period of urethral catheter drainage. Conversion to open and post-operative complications were evenly distributed amongst the four trainees. There were no other perioperative complications and the majority of patients were discharged following post-operative day 1 (range 1-4 days).

Table 1 summarizes both the training experience

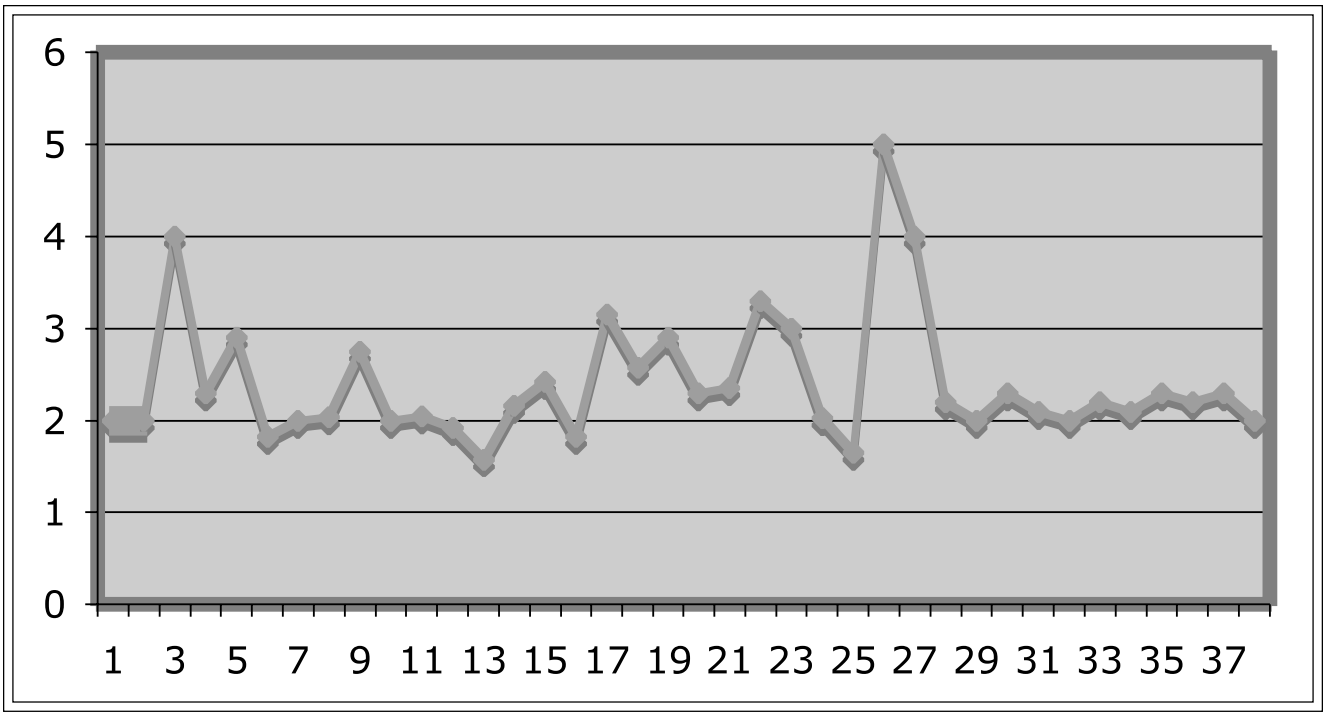

Figure 1. Operative times for consecutive laparoscopic nephrectomies following the mentorship period.

and number of cases each trainee has performed subsequent to the mentorship period. Interestingly, both trainees A and D have more embraced laparoscopy and continue to employ it as a tool for ablative renal procedures when indicated. All trainees report that the mentorship-training model is an effective method to introduce laparoscopy to those with no previous formal laparoscopic training.

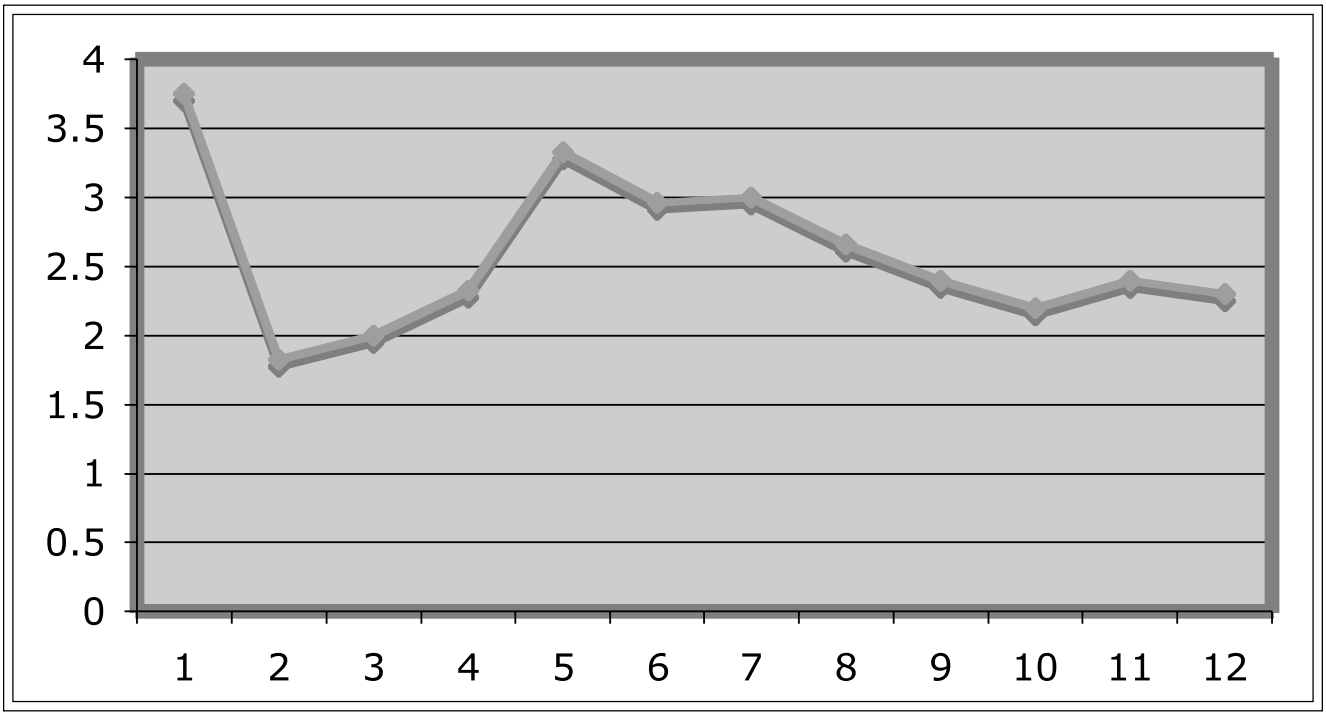

Figure 2. Operative times for consecutive laparoscopic partial nephrectomies following the mentorship period.

TABLE 1. **Summary of laparoscopic experience of each trainee during and subsequent to the mentorship period**

Factor	Trainee A	Trainee B*	Trainee C	Trainee D
Years in practice	16	24	7	5
Hours spent on pelvic trainer/animal lab	4-6	3-5	3-4	6-8
Number of cases trainee				
Observed and assisted	4	4	3	4
Operated partially independently	3	4	4	7
Operated independently	1	2	0	7
Number of cases performed during the post-mentorship period	20	2	3	27

*Trainee B has since left The Hospital for Sick Children and has performed one partial and five total laparoscopic nephrectomies since his departure.

Discussion

Almost 13 years have elapsed since the first report of laparoscopic nephrectomy in a child.[6] Since that time, laparoscopy has been utilized in and has revolutionized a number of urologic subspecialties including oncology and transplantation. Although slower to adopt laparoscopic practices, pediatric urologists are gradually becoming more accepting of laparoscopy for ablative as well as more advanced reconstructive procedures. The gradual emergence of laparoscopy in pediatric urology as compared to our adult counterparts is reflected by the inherent nature of, and conservatism in, treating children. Pediatric urologists in general tend to follow patients for a period of time and only recommend operative intervention in those with well-defined pathologic conditions. This translates to a more conservative operative approach, thereby decreasing ones enthusiasm to adopt new techniques, which do not have the same extended long-term follow-up as older, time-tested open approaches.

Furthermore, a substantially greater proportion of operative pediatric urology constitutes reconstructive, rather than ablative, procedures. As reconstructive laparoscopy is far more advanced than ablative surgery, pediatric urologists tend not to acquire, and maintain, basic laparoscopic skills as easily as adult practitioners with simpler, and more numerous procedures such as nephrectomy.[7] Additionally, the benefits of minimally invasive surgery with respect o decreased morbidity are not as apparent in the pediatric population as compared to adults. Children recover much faster than adults, regardless of the surgical approach, and the economic impact of a child recovering in hospital is much less as lost wages are not a concern (unless both parents or a single caregiver have employment outside of the home). Finally, as demonstrated in this study, most practicing pediatric urologists have little or no formal laparoscopic training. Unfortunately for many, laparoscopy represents an entirely new surgical concept and, therefore, direct extension of skills utilized in daily surgical practice cannot be done in order to master the subtle complexities of laparoscopic surgery.

Previous reports of the acquisition of laparoscopic skills demonstrated that although most initially embraced laparoscopy and incorporated it into their daily practice, subsequent follow-up of these same urologists showed that a significant proportion ultimately abandoned laparoscopy for a variety of reasons.[8, 9] Interestingly, this present group of urologists appears to have followed the same trend. Despite the fact that trainees B and C did feel that the mentorship program was invaluable, neither has fully adopted laparoscopy into their daily practice when indicated. In contrast, trainees A and D have both fully embraced laparoscopy and consider it a tool in the armamentarium of their operative repertoire.

Ongoing case exposure is critical not only to maintain basic surgical skills, but it also allows the surgeon to build on these fundamental skills in order to attempt subsequently more complex procedures. It has recently been recognized that lengthy learning curves exist for novices acquiring laparoscopic skills on a virtual reality surgical simulator. Brunner et al demonstrated that up to 30 repetitions were necessary for trainees to become facile with various laparoscopic maneouvers.[10] Therefore, to build upon and maintain basic laparoscopic skills, adequate exposure to

laparoscopy must continue beyond the training period. We previously reported a relatively large series of 21 patients who underwent laparoscopic retroperitoneal pyeloplasty for PUJ obstruction.[11] Although the operative times were generally long, these reflected the ongoing acquisition of advanced laparoscopic skills such as intracorporeal suturing and knot tying by the trainees in the present study. Since the conclusion of the mentorship program, trainee D (WF) has independently performed a number of laparoscopic-assisted and complete laparoscopic pyeloplasties for PUJ obstruction and credits the graduated exposure and experience gained through the mentorship program to his ability to perform advanced reconstructive laparoscopy.

We have demonstrated that the mentorship-training model is a valuable method to introduce laparoscopy to a pediatric urology training program. The attainment of basic laparoscopic skills can act as a foundation to enable more advanced reconstructive procedures to be performed safely and with facility. The length of hospital stay as well as the low incidence of perioperative complications and low rate of conversion compare favorably to similar series. Our operative times for both nephrectomy and partial nephrectomy remained relatively stable; we attribute this to the fact that our institution is a fellowship and residency-training program, which intimately involves trainees in all aspect of surgery. Consequently, our operative times may remain stable secondary to this intangible "trainee effect". As with all new surgical techniques, ongoing case exposure is imperative in order to maintain and improve laparoscopic skills following the training program, which ultimately leads to the final plateau on the learning curve as an expert laparoscopist. □

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