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SURGICAL ENDOSCOPY
and Other Interventional Techniques

Health-related quality of life after laparoscopic and open nephrectomy

K. T. Pace,[1] S. J. Dyer,[1] R. J. Stewart,[1] R. J. Honey,[1] E. C. Poulin,[2] C. M. Schlachta,[2] J. Mamazza[2]

[1] Division of Urology, St. Michael's Hospital, University of Toronto, Ontario, Canada
[2] Division of Minimally Invasive Surgery, St. Michael's Hospital, University of Toronto, Ontario, Canada

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Abstract
Background: Postoperative recovery often is assessed with parameters (pain and return to work) susceptible to bias. This study sought objectively to compare postoperative health-related quality of life (HRQL) after laparoscopic and open nephrectomy with the Postoperative Recovery (PRS) (a validated questionnaire designed to assess pain), activities of daily living (ADL), and HRQL in postoperative patients.
Methods: Patients undergoing contemporaneous laparoscopic and open nephrectomy received the PRS pre- and postoperatively. The results were analyzed with analysis of covariance (ANCOV) and survival analysis.
Results: The 33 open nephrectomy and 38 laparoscopic patients in this study were comparable in age, gender, body mass index (BMI) and employment. Laparoscopic operative time was longer ($p = 0.015$), and the hospital stay was shorter ($p < 0.001$). Laparoscopic patients had higher HRQL scores from postoperative days 3 to 365 ($p < 0.001$), and they returned to preoperative HRQL faster ($p < 0.001$). *Conclusions:* An objective HRQL instrument confirms that laparoscopic nephrectomy patients recover faster and with a higher HRQL than open surgery patients. The PRS can be modified for use after other abdominal procedures, and may prove useful for comparisons of other minimally invasive surgical techniques.

Key words: Nephrectomy — Laparoscopy — Quality of life — Measurement — Reliability — Validity

Although laparoscopic techniques were first described in 1901 [11], the first laparoscopic nephrectomy was reported in 1991 [4]. The past decade since then has seen an explosion in urologic laparoscopic procedures, largely because of significant advances in laparoscopic instrumentation, imaging systems, and surgical techniques. As a result, laparoscopic nephrectomy has become much more widespread [6]. Currently, laparoscopic approaches are routinely applied to a variety of benign [13] and malignant [15] renal conditions, as well as to living donor nephrectomy patients [16]. This profusion of laparoscopic approaches to renal surgery has resulted largely from the presumed patient benefits of reduced postoperative hospital stay, decreased postoperative pain and narcotic use, shortened period of postoperative convalescence, more rapid return to work and normal activities, and professional interest in embracing new technology [7].

Nonetheless, data on patient quality of life (QOL) after laparoscopic as compared with open nephrectomy is extremely limited. In fact, there is little data in the literature on objective assessment of QOL after open nephrectomy, aside from that on living donor nephrectomy [9, 10], although the morbidity of flank incisions is well established [5, 12, 17]. Most existing comparisons of laparoscopic and open nephrectomy rely on measures susceptible bias or error, such as length of stay, which often is determined by the same surgeon who carries out the procedure, and return to work, which can be influenced by the nature of the employment and the presence or absence of disability insurance. Postoperative QOL is a complex multidimensional construct that encompasses pain, ability to perform the activities of daily living (ADL), patient satisfaction, overall sense of general well-being, surgical success, perception of change as compared with the preoperative state, and surgical complications encountered by patients as they recover from a surgical procedure. A literature review of MEDLINE and HAPI from 1981 to 2001 using the search terms "surgery," "postoperative," "recovery," "instrument development," "measurement," "quality of life," "QOL," and "health-related quality of life (HRQL)" showed that no instrument is available to assess each of these domains for postnephrectomy pa-

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Correspondence to: K. T. Pace

tients. However, instruments have been developed and validated for cardiac bypass surgery, hip surgery, and tonsillectomy [2, 3, 14]. An alternative to the development of a disease-specific (or operation-specific) instrument would be to use existing generic HRQL instruments such as the Short Form-36 (Acute) [19], the Nottingham Health Profile (NHP) [8], or the Sickness Impact Profile (SIP) [1]. However, such generic instruments often prove to be insufficiently sensitive to detect small but important HRQL differences in postoperative patients, as has been found in colectomy patients [20]. In addition, none of these generic instruments are designed for surgical patients, or to encompass all the facets of postoperative recovery because most were designed for debilitated medical patients.

We sought to examine QOL after open and laparoscopic nephrectomy using the Postoperative Recovery Scale (PRS), a validated self-administered questionnaire based on the SF-36 acute [19], but modified to increase responsiveness to change and to improve ability to discriminate differences in postnephrectomy patients. Three versions of the PRS are available, designed for administration preoperatively, postoperatively while the patient is in the hospital, and postoperatively on an outpatient basis. The instrument is designed to assess ADL, HRQL, pain, and change from preoperative state.

Materials and methods

Patients

Beginning July 1, 2000, patients undergoing laparoscopic or open nephrectomy at St. Michael's Hospital, University of Toronto, were approached to participate in a prospective assessment of HRQL before and after surgery. Patients with asymptomatic, organ-confined renal cell carcinoma planned for radical nephrectomy, asymptomatic renal pathology mandating simple nephrectomy, or living donor nephrectomy were eligible for participation. Patients with cognitive impairment, inability to read English, lack of a telephone at home or place of employment, or metastatic or locally advanced malignancy were excluded from the study. All patients were evaluated preoperatively with a spiral computed tomogram (CT) of the abdomen and pelvis using three-dimensional reconstruction of the renal vasculature (CT angiogram). Patients with solid, enhancing renal lesions (presumed renal cell carcinomas) were evaluated with a CT scan, bone scan, and chest x-ray to rule out metastatic disease. Data on patient demographics, indication for surgery, perioperative course, in-hospital postoperative convalescence, and HRQL were collected. The study protocol was approved by the institutional review board, and all the patients provided written informed consent.

QOL assessment

The PRS is a validated self-administered questionnaire based on the SF-36 Acute [19]. Three versions of the PRS are available for administration preoperatively (26 items; maximum score, 107), postoperatively while the patient is in the hospital (21 items; maximum score, 85), and postoperatively on an outpatient basis (31 items; maximum score, 127; see Appendix 1). The ADL and HRQL items were derived directly from the SF-36 Acute. All the items have response categories from 0 to 5 or from 0 to 4, with written descriptors for each response category. Flank and abdominal pain items are assessed with visual analog scale items converted to scores of 0 to 5. Items to assess change from the preoperative state have response categories from 0 to 5, with written descriptors for each response category. The overall PRS score is a total of all the items, with a higher score indicating greater QOL. Scores for each version of the PRS were converted to a maximum percentage (based on the maximum achievable score for each version) to allow comparison of scores before and after surgery.

All the patients received the PRS preoperatively on two separate occasions at least 2 weeks apart in the same outpatient clinic environment to assess test–retest reliability and provide baseline HRQL scores. After surgery, the patients received the PRS during each day of their hospital stay, then on an outpatient basis 2 weeks, 4 weeks, 8 weeks, 3 months, 6 months, and 1 year after surgery. All PRS assessments were self-administered, and completed by the patients alone in their hospital room or in a private office before their clinical consultation with the surgeon.

Surgery

All open nephrectomies were performed by two urologists via a supra-11th or supra-12th rib incision, as selected by the surgeon on the basis of patient anatomy. A non–rib-resecting, extrapleural, extraperitoneal technique was used to approach the kidney. All laparoscopic nephrectomies were performed by two minimally invasive surgeons. A fully laparoscopic, transperitoneal dissection was performed with patients in the flank position. The intact specimen was extracted inside an impermeable bag through a lower quadrant incision. For laparoscopic donor nephrectomy patients, an access incision was made in the left lower quadrant to allow hand insertion for rapid renal extraction just before the renal artery and vein were clipped.

Intraoperative conversion to open nephrectomy was allowed at the surgeon's discretion. Conversion was carried out via a subcostal incision and a transperitoneal approach to the kidney. Laparoscopic patients with operative conversion were analyzed with the laparoscopic group in an intention-to-treat fashion. Selection of laparoscopic or open approach to nephrectomy was nonrandomized. Patients were offered both treatment approaches. After meeting with both open and laparoscopic surgeons and a research coordinator, they selected the treatment modality with which they were most comfortable.

Statistical analysis

The primary end point of this study was change in postoperative QOL, as reflected in the PRS scores. Sample size was calculated after pilot testing of the PRS on 20 nephrectomy patients to determine postoperative mean scores and variances. As a result, a minimum sample size of 62 patients was calculated as necessary to obtain a 95% confidence interval of a 15% difference in PRS scores between laparoscopic and open surgery patients 3 months after nephrectomy with a two-sided test. Sample size was inflated by 15% to allow for possible missing data and withdrawals, for a final sample size of 71. This sample size also was determined to be adequate for accurate assessment of test–retest reliability (calculated to be 46 on the basis of data from Walter et al. [18], assuming ρ_0 of 0.8, ρ_1 of 0.9, type 1 error of 5%, power of 20%, with two testing periods).

All comparisons were based on the intention-to-treat principle, and patients were analyzed in the group to which they had been assigned (i.e., laparoscopic conversions were analyzed in the laparoscopic group). Test–retest reliability of the PRS was calculated using the intraclass correlation coefficient (ICC), with variance estimates provided by repeated measures analysis of variance (ANOVA) on the overall PRS score, and for each domain (pain, ADL, and HRQL) within the PRS using a random effects model. Postoperative QOL was compared using analysis of covariance (ANCOVA), with the baseline (preoperative) score as a covariate, after the assumption of normality was tested and the homogeneity of variances was assessed with Levene's test. For cases with missing intermediate QOL assessment scores, linear regression using individual patient data was used to interpolate when two or more QOL scores were available. Otherwise the case was dropped from the ANCOVA model. Secondary end points, including baseline values and surgical outcomes, were compared with *t*-tests for normally distributed data, and with chi-square or Mann–Whitney tests where appropriate. The time required for patients to return to 75% of their baseline PRS score after nephrectomy was calculated using survival analysis and the log-rank statistic. Exploratory modeling to examine other predictors of postoperative QOL was planned a priori to test the hypotheses that other covariates such as

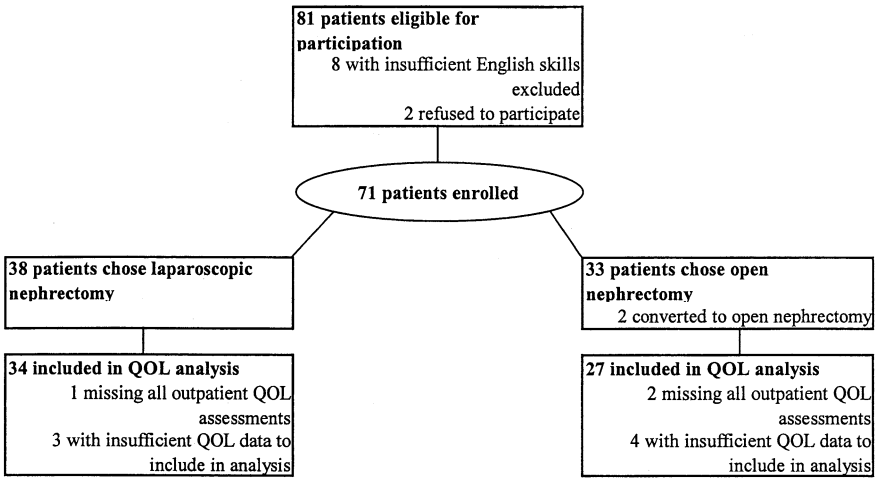

Fig. 1. Trial patient flow diagram.

Table 1. Baseline values

	Number (%) choosing laparoscopic nephrectomy (n = 38)	Number (%) choosing open nephrectomy (n = 33)	P
Mean age	42.8 ± 12.4	39.9 ± 13.9	0.704
Gender n (%)			0.406
Female	24 (63.2)	19 (57.6)	
Male	14 (36.8)	14 (42.4)	
Side n (%)			0.179
Right	10 (26.3)	13 (39.4)	
Left	28 (73.7)	20 (60.6)	
Mean BMI (kg/m^2)	27.3 ± 5.5	27.6 ± 4.9	0.864
Type of employment n (%)			0.821
Self-employed	2 (5.3)	3 (9.1)	
Sedentary	24 (63.2)	20 (60.6)	
Physically active	12 (31.6)	10 (30.3)	
Mean preoperative QOL score	104.1 ± 7.0	104.6 ± 4.4	0.354
Operation n (%)			0.443
Radical nephrectomy	6 (15.8)	7 (21.2)	
Simple nephrectomy	2 (5.2)	4 (12.1)	
Donor nephrectomy	30 (78.9)	22 (66.7)	

BMI, body mass index; QOL, quality of life

age, gender, body mass index (BMI), indication for surgery, and nature of employment may affect outcome. All p values reported are two-tailed, and a value of p less than 0.05 was chosen to denote statistical significance.

Results

Patients

Study enrollment began July 1, 2000, and 81 patients eligible for participation were approached. Eight patients were ineligible because of their inability to read or write English well enough to complete the instrument, and two refused to participate. The remaining 71 patients were enrolled, with 38 (53.5%) choosing laparoscopic nephrectomy and 33 (46.5%) choosing an open nephrectomy. Complete QOL data were available for 61 patients: three patients failed to complete the HRQL instrument after discharge from hospital, and data were collected for seven patients only up to 12 weeks postoperatively (Fig. 1). These 10 patients baseline characteristics similar to those of the other 61 patients with complete QOL data. Table 1 illustrates pertinent baseline characteristics of the two groups. They were similar in age, gender, body mass index (BMI), indication for surgery, side of surgery, and preoperative HRQL score

Clinical outcomes

Perioperative clinical outcomes relevant to the QOL analysis are illustrated in Table 2. Two patients (5.3%) in the laparoscopic group required operative conversion: one for bleeding from a lumbar branch of the renal vein, and the other, a donor nephrectomy patient, for inadequate visualization of the renal vessels. Their data were analyzed with the laparoscopic group in an intention-to-treat fashion. Laparoscopic nephrectomy patients had significantly longer operative times, less estimated operative blood loss, shorter hospital stays, and more rapid return to employment or full care-giving activities (if they were not employed in the workforce but cared for children). In the laparoscopic patients there was a trend

Table 2. Clinical outcomes

	Laparoscopic nephrectomy (n = 38)	Open nephrectomy (n = 33)	
Mean operative time (min)	224.5 ± 53.8	133.8 ± 28.5	0.015
Mean estimated blood loss in (ml)	86.3 ± 52.6	135.9 ± 84.1	0.012
Mean inpatient morphine equivalent narcotic use (oral and parenteral) (mg)	114.6 ± 85.4	153.4 ± 130.0	0.07
Inpatient length of stay (days) as median (range)	4 (3–8)	6 (4–11)	<0.001
Time to return to work (days) as median (range)	18 (5–40)	46 (14–64)	<0.001

Table 3. Test–retest reliability

	ICC with occasion fixed (95% CI)	ICC with occasion random (95% CI)
Overall PRS	0.85 (0.71–0.94)	0.81 (0.69–0.92)
Pain subscale	0.71 (0.49–0.88)	0.67 (0.47–0.87)
ADL subscale	0.81 (0.65–0.91)	0.77 (0.61–0.88)
HRQL subscale	0.76 (0.61–0.89)	0.72 (0.55–0.78)

ICC, internal conversion coefficient; PRS, postoperative recovery scale; ADL, activities of daily living; HRQL, health-related quality of life

Table 4. Univariate analysis of postoperative recovery scale scores before and after nephrectomy

	Inpatient				Outpatient					
	Preop	Day 1	Day 2	Day 3	2 weeks	1 month	2 months	3 months	6 months	12 months
Open										
n	33	33	33	33	27	27	27	27	27	27
Mean	104.64	30.39	33.01	35.55	60.10	76.93	91.05	100.95	111.62	120.29
SD	4.44	11.24	12.21	13.85	21.53	22.13	23.03	26.03	19.92	11.04
Lap										
n	38	36	36	37	34	34	34	34	34	34
Mean	104.10	27.73	29.99	35.05	71.03	92.91	109.72	118.02	122.66	125.50
SD	7.03	12.57	13.59	14.81	22.18	22.73	16.45	13.38	9.35	3.44
p	0.7039	0.3589	0.3367	0.8848	0.0577	0.0077	0.0005	0.0016	0.0058	0.0116

Preop, preoperatively

toward using fewer narcotic analgesics (both oral and parenteral) while in hospital after surgery (p = 0.07).

There were no perioperative deaths in either group. Perioperative morbidity also was acceptable. In the laparoscopic group there were four pneumothoraces (no chest tubes), one episode of urinary retention (resolved within 24 h), one episode of gluteal myonecrosis (completely resolved within 4 weeks), and two wound infections. In the open nephrectomy group, there were nine pleurotomies during surgery (no chest tubes), two cases of prolonged ileus (>5 days), two cases of flank neuralgia persistent 6 months postoperatively, one wound infection, one case of intraoperative ST segment changes (with no evidence of perioperative myocardial infarction), and one unexplained episode of diarrhea.

QOL assessment

Test–retest reliability of the PRS was assessed preoperatively, when patients were felt to be clinically stable. Intraclass correlation coefficients for the overall scale, and for the three domains within the scale, are shown in Table 3. Values assuming both a random- and a fixed-effects model are provided. Mean PRS QOL scores, with univariate comparisons at each point in time, are shown in Table 4. Both groups had similarly high scores preoperatively, but significant differences are seen between the groups at the 1-month, 2-month, 3-month, 6-month, and 1-year postoperative assessments. The laparoscopic patients show significantly higher QOL scores during each of these time periods than the open nephrectomy patients ($p<0.05$ at each time point). In the multivariable analysis, the differences between the two groups became more pronounced. This is demonstrated graphically in Fig. 2: laparoscopic nephrectomy patients show consistently higher PRS QOL scores from hospital discharge to 1 year postoperatively, although the gap between the laparoscopic and open surgical patients begins to narrow from 6 months postoperatively onward (summary statistic ANCOVA: $F(8,464) = 5.349$; $p < 0.001$). If analysis of the data is limited to the first 3 months after surgery, the differences between the groups are even more dramatic. The median time required for laparoscopic nephrectomy patients to return to at least 75% of their baseline PRS QOL score was 33 days (95%

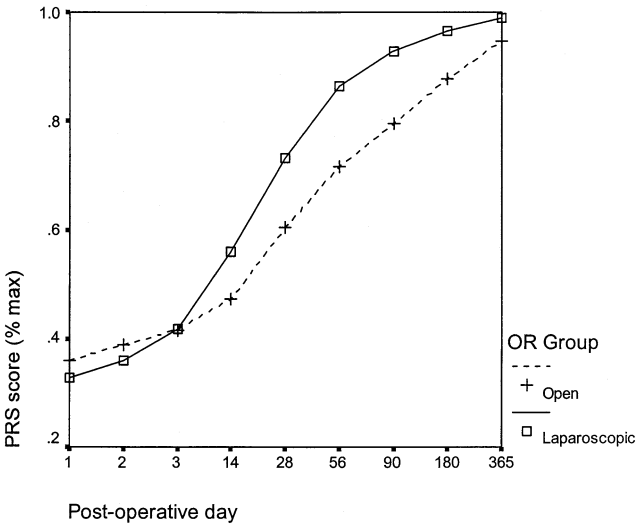

Fig. 2. Health-related quality of life after laparoscopic and open nephrectomy. Repeaed measures ANCOVA, F(8,464) = 5.349, $p < 0.001$.

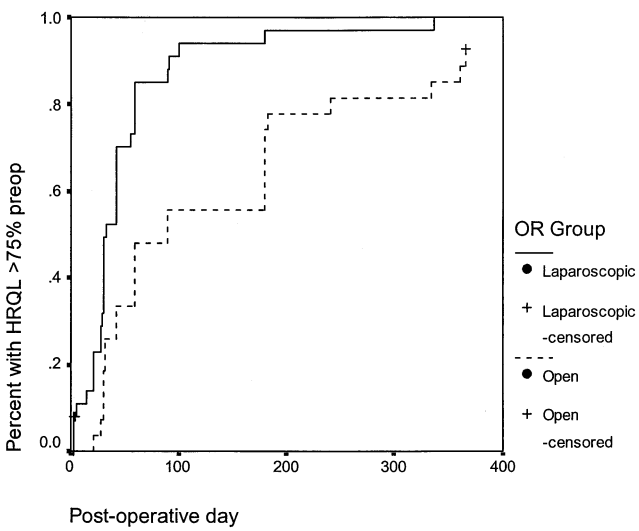

Fig. 3. Survival analysis of time to return to 75% of preoperative health-related quality of life score. Log rank statistic = 14.34, $p < 0.001$.

CI, 26–40), as compared with 90 days (95% CI, 50–130) for the nephrectomy open patients (log rank, 14.34; $p < 0.001$), as illustrated in the survival table in Fig. 3. Exploratory modeling of the data with ANCOVA showed that age ($p = 0.705$), gender ($p = 0.210$), side of surgery ($p = 0.238$), and type of employment (sedentary vs physically demanding; $p = 0.198$) were not statistically significant in predicting postoperative PRS scores. But indication for surgery did have an impact on rapidity of postoperative recovery: donor nephrectomy patients recovered substantially more slowly than nondonor nephrectomy (radical nephrectomy and simple nephrectomy) patients (F [6,336] = 2.640; $p = 0.016$). In addition, BMI also had an impact on postoperative recovery: patients with greater BMIs recovered more slowly from surgery (F [6,336] = 2.630; $p = 0.020$).

Discussion

Our findings demonstrate that HRQL is substantially greater after laparoscopic nephrectomy than after open nephrectomy. As would be expected, HRQL scores are similarly low for both groups of patients immediately after surgery. They then begin to return to baseline values more rapidly in laparoscopic patients, starting 2 weeks postoperatively. In the laparoscopic group, HRQL scores remain higher during every period, even up to 1 year postoperatively ($p = 0.0116$). Whereas 50% of laparoscopic patients return to 75% of their baseline QOL score within 1 month of surgery, open nephrectomy patients require nearly three times as long (up to 90 days) to achieve the same outcome. This confirms the traditional view that most patients require up to 3 months to recover from an open, flank incision, but ignores the fact that QOL remains significantly impaired in open nephrectomy patients even 6 months and 1 year after surgery, with many still reporting of mild discomfort and stiffness.

The primary analysis was based on the intention-to-treat principle. Thus, operative conversions were included in the laparoscopic arm of the analysis, somewhat diluting the differences between the laparoscopic and open nephrectomy groups. An "as allocated" analysis, whereby the HRQL outcomes of operative conversions are included in the open nephrectomy arm, showed a more dramatic HRQL advantage. Patients who successfully undergo a laparoscopic nephrectomy have HRQL scores 29.9% higher than those of open nephrectomy patients 3 months after surgery (PRS score, 126.3 vs 97.2; $p < 0.05$), as compared with a 20.6% advantage when the operative conversions are included in the laparoscopic group (intention to treat). The HRQL advantage of the laparoscopic approach is seen primarily if the procedure is completed laparoscopically. If conversion rates to open surgery are high, then the HRQL advantage may be compromised.

Although this study was nonrandomized and reflects a prospective patient self-selection study, the two groups of patients appear to be similar in a number of important factors that might predict outcome: age, gender, occupation, BMI, and reason for undergoing nephrectomy. Nonetheless, the lack of randomization cannot correct for selection or allocation biases: patients motivated to recover from surgery quickly or return to work sooner are more likely to choose the laparoscopic option. The QOL differences between the two surgical groups, however, are reinforced by the significant differences seen in other end points: length of hospital stay, time to return to work, and the trend toward a difference in narcotic use.

The ability of the PRS instrument to detect differences in patients after laparoscopic and open nephrectomy, where other instruments have been unsuccessful in colectomy patients [20], may result from a number of factors. The morbidity of an open flank incision has been well documented [5, 12, 17]. The incremental benefit of a laparoscopic approach in avoiding this incision may be greater than seen with a laparoscopically assisted colectomy. Furthermore, the PRS was designed

specifically for postoperative nephrectomy patients, with items specifically tailored to assess ADL and pain of patients after surgery. These features increase its ability to detect differences in postnephrectomy patients over that when only the unmodified SF-36 acute is used, and to do so with smaller sample sizes. Interestingly, the exploratory secondary analysis showed that obese patients and patients undergoing a donor nephrectomy appear to recover more slowly from surgery. For donor nephrectomy patients, this may reflect the purely elective nature of the procedure, and also the fact that these patients tend to be younger than radical and simple nephrectomy patients, and more likely to be employed or caring for others, with increased ensuing physical demands. These findings warrant further examination.

Although there are statistically significant differences in HRQL scores after laparoscopic and open nephrectomy, it is important to determine whether these differences are clinically significant. Unfortunately, there as yet is no straightforward way to convert a difference in PRS scores into a clinically relevant measure. However, the PRS scores of the laparoscopic nephrectomy patients were 20.6% higher than those of the open nephrectomy patients 3 months after surgery. This translates to average scores 0.55 higher on each item of the questionnaire, or to scores 1 point higher (out of 5) on half the items. This likely represents quite a clinically significant difference between groups. In addition, the instrument demonstrates a test–retest reliability of 0.81 in a random effects model, which is quite acceptable for a HRQL measure, and approaches that of the SF-36 Acute [19]. In fact, using the PRS to provide a more objective assessment of recovery after surgery is likely to give a more accurate and less biased indication of patient HRQL than other flawed measures such as return to work, narcotic use, or global assessments of patient status by physicians.

Conclusions

Application of an objective HRQL instrument confirms that patients undergoing laparoscopic nephrectomy experience substantially higher quality-of-life scores, as assessed by the Postoperative Recovery Scale (PRS), up to 12 months after surgery than open nephrectomy patients. The PRS is a reliable and valid instrument for use with postnephrectomy patients (Appendix 1). With modification, it could be applied to a broad spectrum of postsurgical patients to provide a more objective assessment of postoperative recovery and HRQL. These findings should be confirmed with randomized trials to avoid issues of selection and allocation bias.

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Appendix 1:

OUT-PATIENT PRS

Patient Name:

Date: _____
DD/MMM/YY

Visit (circle one): **2 Weeks** **1Month** **2 Months** **3 Months** **6 Months** **1 Year**

For the following questions, draw a vertical mark on the line:

1. How much flank or side pain do you have when sitting or lying still?

No pain at all — **Pain as bad as it could be**

2. How much abdominal pain do you have when sitting or lying still?

No pain at all — **Pain as bad as it could be**

3. How much flank or side pain do you have when moving or walking?

No pain at all — **Pain as bad as it could be**

4. How much abdominal pain do you have when moving or walking?

No pain at all — **Pain as bad as it could be**

5. How much pain do you have when lifting objects?

No pain at all — **Pain as bad as it could be**

6. How well does your pain medication control your pain

It controls it completely (No Pain) — **It does not control it at all (Pain as bad as it could be)**

7. How much does your pain bother you?

Not at all — **Severely**

Outpatient PRS © Kenneth Pace, MD, MSc, FRCSC Page 1 of 4

Fig. 4. The outpatient postoperative recovery scale (PRS). (Continued an pages 150–152.)

Circle ONE answer to describe how you have felt over the LAST WEEK:

8. How much did your pain interfere **(or *WOULD* it have interfered)** with work **OR** normal daily activities?
   - I had no pain..... 5
   - Not at all..... 4
   - Slightly..... 3
   - Moderately..... 2
   - Quite a bit..... 1
   - Extremely..... 0

9. How much pain did you have IN THE LAST WEEK compared to before your operation?
   - A lot less than before the operation..... 5
   - A little less than before the operation..... 4
   - About the same amount as before the operation..... 3
   - Slightly more than before the operation..... 2
   - Moderately more than before the operation..... 1
   - Much more than before the operation..... 0

During the LAST WEEK, how well have you been able, <u>OR</u> how well *WOULD YOU HAVE BEEN ABLE,* to: (circle ONE):

	Not at all	With great difficulty	With some difficulty	With slight difficulty	With no difficulty
10. Perform your duties at work **<u>OR</u>** normal daily activities? ***If you haven't returned to work, try to imagine what it would be like if you'd had to work this past week.**	0	1	2	3	4
11. Look after other people (children or others who depend on you)?	0	1	2	3	4
12. Perform vigorous activities (like running, lifting heavy objects, playing strenuous sports)?	0	1	2	3	4
13. Perform moderate activities (like vacuuming, bowling or golfing)?	0	1	2	3	4
14. Climb one flight of stairs?	0	1	2	3	4
15. Climb more than 1 flight of stairs?	0	1	2	3	4
16. Walk 1 block?	0	1	2	3	4
17. Walk several blocks?	0	1	2	3	4
18. Walk 1 mile?	0	1	2	3	4
19. Walk more than 1 mile?	0	1	2	3	4
20. Carry groceries?	0	1	2	3	4
21. Bathe or get dressed by yourself?	0	1	2	3	4
22. Bend or kneel down?	0	1	2	3	4

Fig. 4. Continued

During the LAST WEEK (circle ONE):

	All the time	Most of the time	Some of the time	A little of the time	None of the time
23. Have you been able to finish work **OR your normal daily activities?**	4	3	2	1	0
24. Have you been forced to cut down on the *type* of work **OR activities?**	0	1	2	3	4
25. Have you been forced to cut down on the *amount of time* you spend on work **OR activities?**	0	1	2	3	4

26. How well are you able to do work **OR** your normal daily activities compared to before your operation?
    - Much better now than before the operation.....5
    - Somewhat better now than before the operation.....4
    - About the same as before the operation..... 3
    - Slightly worse than before the operation..... 2
    - Moderately worse than before the operation..... 1
    - Much worse than before the operation..... 0

Circle ONE:

27. Overall, how would you describe your health NOW?
    - Excellent..... 4
    - Very good..... 3
    - Good.....2
    - Fair..... 1
    - Poor..... 0

28. Overall, how would you describe your health NOW compared to other people?
    - Much worse..... 0
    - Somewhat worse..... 1
    - About the same..... 2
    - Somewhat better..... 3
    - Much better..... 4

29. Overall, how would you describe your health NOW compared with before your operation?
    - Much better now than before the operation.....5
    - Somewhat better now than before the operation.....4
    - About the same as before the operation..... 3
    - Slightly worse than before the operation..... 2
    - Moderately worse than before the operation..... 1
    - Much worse than before the operation..... 0

30. Overall, how well do you feel PHYSICALLY right now?
    - Excellent..... 4
    - Very good..... 3
    - Good.....2
    - Fair..... 1
    - Poor..... 0

Fig. 4. Continued.

31. Overall, how well do you feel PHYSICALLY right now compared with before your operation?
    Much better now than before the operation.....5
    Somewhat better now than before the operation.....4
    About the same as before the operation..... 3
    Slightly worse than before the operation..... 2
    Moderately worse than before the operation..... 1
    Much worse than before the operation..... 0

Fig. 4. Continued.