CLINICS

CLINICAL SCIENCE

Pfannenstiel incision for intact specimen extraction in laparoscopic transperitoneal radical nephrectomy: a longitudinal prospective outcome study

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OBJECTIVES: To evaluate the intra- and postoperative outcomes of patients undergoing laparoscopic radical nephrectomy with intact specimen extraction through a Pfannenstiel transverse suprapubic incision.

METHODS: Prospective follow-up of 26 laparoscopic transperitoneal radical nephrectomies for suspected renal tumors in which the kidneys were extracted via a Pfannenstiel lower abdominal transverse incision.

RESULTS: The mean operating time was 152.3 (80-255) minutes, and the mean blood loss was 90 (20-300) ml. The mean extraction time was 20.4 (12-35) minutes. The mean weight of the removed specimen was 631.5 (190-1505) grams, and the mean longest diameter of the extracted specimen was 17.4 (9-25) cm. The mean extraction incision size was 10.7 (7-16) cm. No open surgical conversions were necessary. Pain control was excellent, with minimal intravenous morphine equivalent narcotic use by patients: 15.7 (0-31) mg in the recovery room, 33.8 (0-127) mg on the first postoperative day and 8.7 (0-60) mg in the first week after discharge. The patients experienced a short duration to full ambulation and normal dietary intake. Postoperative follow-up visits were recorded for at least six months. The patients reported a high cosmetic satisfaction rate of 97.7% (60-100). No late postoperative complications were observed related to the extraction site.

CONCLUSIONS: The operative specimen can be extracted via a low transverse Pfannenstiel incision during radical laparoscopic nephrectomy. This incision ensures the extraction of large specimens while preserving the aesthetic and functional advantages of laparoscopy without increasing the cancer risk. The absence of muscle cutting maintains the integrity of the abdominal wall and elicits minimal pain. No postoperative incisional hernias or keloid formations were observed.

KEYWORDS: Pfannenstiel; Extraction site; Intact specimen; Laparoscopy, Nephrectomy.

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INTRODUCTION

Laparoscopic surgery gained widespread acceptance with the advent of laparoscopic cholecystectomy (1). The benefits of small trocar site incisions versus large, muscle-cutting, open incisions were immediately apparent. Subsequently, laparoscopic techniques were applied to advanced urologic kidney procedures such as simple nephrectomy (2), radical nephrectomy (3), radical nephroureterectomy (4), and donor nephrectomy (5). However, because of the larger specimen size, simple extractions cannot be performed in a manner analogous to that in cholecystectomy.

When considering cosmesis, some surgeons may be reluctant or may feel it unwarranted to make a "new" incision during laparoscopic surgery for intact specimen removal. For this reason, as well as to minimize the extraction incision, intracorporeal morcellation (for non-donor nephrectomy cases) has been used at many centers (6). However, questions have arisen regarding the adequacy of surgical staging and the risk of tumor implantation when specimens are destroyed during cancer surgery (7).

Intact operative specimen extraction has been performed by extending a port site incision, connecting two port sites, using the incision of a prior abdominal scar or creating a new incision. Surgeons commonly choose transverse abdominal incisions because they achieve good cosmetic results with potentially less pain compared with incisions of other orientations (8). Intact specimen extraction through a transverse lower flank muscle-cutting incision may result in a higher risk for an incisional hernia, especially in patients with other risk factors (9,10). Matin and Gill (11) described

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the use of a modified Pfannenstiel (PFN) incision for specimen retrieval after retroperitoneoscopic renal surgery. Although a formal analysis comparing different types of incisions was not performed in their study, the authors felt that this approach provided increased patient comfort and cosmesis compared with the use of an expanded lateral port site.

An extended PFN incision may not be completely benign. This extraction may be more difficult in obese patients due to accessibility issues. Additionally, ilioinguinal or iliohypogastric neuropathy has a reported incidence as high as 3.7% after such incisions due to incorporation of the nerve with a suture during facial closure, direct nerve trauma with or without neuroma formation, or constriction of the nerve during scar or wound healing. Symptoms may occur immediately or be delayed, and they typically cause burning pain in the lower abdomen, upper medial thigh, and pelvic region with altered skin sensitivity in the inguinal area (10).

As patient quality of life is an important parameter that is often reported in the urological literature, we aimed to evaluate the intra- and perioperative outcomes as well as the 6-month follow-up outcomes of patients undergoing laparoscopic radical nephrectomy with intact specimen extraction through a non-muscle-cutting PFN transverse incision.

To the best of our knowledge, no previous prospective longitudinal study has evaluated the outcomes of intact specimen extraction through a PFN incision in laparoscopic radical nephrectomy procedures or has included a patient quality of life questionnaire.

PATIENTS AND METHODS

From March 2009 to February 2013, laparoscopic nephrectomy through a PFN incision was performed in 26 non-randomized patients in our service by a single surgeon. The research protocol was approved by the ethics committee of our hospital, and all the patients provided written informed consent for the surgery. Data were prospectively collected for subsequent analysis.

The inclusion criteria specified all patients over 18 years old with localized renal cancer who would undergo laparoscopic radical nephrectomy. The exclusion criteria included procedures with conversion to open nephrectomy, hand-assisted laparoscopic nephrectomy, non-PFN incision extraction sites, nephrectomy for non-cancerous cases, the use of epidural or patient control analgesia, and skin infiltration with local anesthetic agents during or after the surgery.

All the patients underwent transperitoneal laparoscopic nephrectomy under general anesthesia. Operative, perioperative, and one-week, 6-week, and 6-month postoperative parameters were analyzed, including specimen weight and size (maximum diameter), incision length, total operating time, extraction time, estimated blood loss (EBL), length of hospital stay, pain score in the postoperative holding area and on the first postoperative day (POD), narcotic consumption, time to fluid intake/full dietary intake, time to unassisted ambulation, cosmesis, and wound-related complications. During each follow-up visit, patients' pain scores, postoperative complications and narcotic consumption were recorded. They were also asked to complete a postoperative quality of life questionnaire (Appendix 1). Pain scores were recorded using the visual analogue scale (VAS), where (0) = no pain and (10) = worst pain imaginable. Total operative time was defined as the time between the initial port skin incision and the completion of wound closure. Specimen extraction time was defined as the time between the extraction site skin incision and the completion of facial closure. Narcotics consumption was converted to intravenous morphine sulfate equivalents according to a standard formula.

Surgical technique

Informed consent was obtained from all the patients for laparoscopic radical nephrectomy, and preoperative antibiotics were used routinely. Bowel preparation is not routinely performed for upper urinary tract laparoscopic surgeries.

Our surgical technique has been previously described (12). In brief, the patient is placed in the lateral decubitus position, and the operative table is then flexed to open the costophrenic angle. The surgeon and the assistant stand anterior to the patient. Video monitors are located at the head of the operating table on both sides. A 15-mm Hg carbon dioxide pneumoperitoneum is established with a Veress cannula that is placed at the apex of the umbilicus or alternatively using the 12-mm Optiview direct laparoscopic access technique. Two or three additional ports of varying sizes (5-12mm) are placed under direct vision in the subxiphoid region, iliac fossa, and flank as required in a gentle arc-like shape. An additional 5-mm port is used at the subxiphoid region to retract the liver for right-sided nephrectomy.

A 0˚-viewing 10-mm laparoscope is inserted initially for port insertion and is then exchanged with a 30˚-viewing 10-mm laparoscope that is used throughout the procedure. On the right side, the colon is mobilized toward the midline, and the duodenum is kocherized to expose the kidney. On the left, the descending colon and the splenic flexure are mobilized medially to optimize the exposure of the entire kidney. The lateral border of the inferior vena cava (on the right) can be used as a guide to the right renal vein to aid in its identification. The ureter identified at the pelvic brim (right or left) can also be used as a landmark and followed proximally to the hilum. If necessary, extra 5-mm ports are inserted and used to negotiate a large cancerous kidney. Both the artery and ureter are divided after being controlled by multiple titanium clips. The renal vein is divided using an EndoGIA device (Covidien, USA). The adrenal gland is preserved whenever possible.

After completing the laparoscopic kidney dissection, the specimen is entrapped in a specimen retrieval bag, and a transverse PFN skin incision is then made above the symphysis pubis over a skin crease. The fatty subcutaneous tissues are then freed, exposing the underlying rectus abdominis muscles. The anterior rectus sheath is opened transversely by sharp dissection. After the cranial-cut aponeurosis is elevated under tension, the rectus muscles are separated in the midline, and the peritoneum is perforated in an identical manner using the vertical midline incision. The drawstring of the closed bag is then grasped, allowing the entrapped intact specimen to be removed through the PFN incision. The extraction incision is then closed in layers, and the pneumoperitoneum is re-created to inspect for hemostasis. The abdomen is deflated, and the 10-12-mm trocar incisions are closed under direct vision with absorbable sutures. The 5-mm ports are closed only at the skin level.

Data Analysis

For comparative statistics, Fisher's exact test and the nonparametric Mann-Whitney U test were used, as appropriate.

Table 1 - Perioperative patient, surgery and specimen characteristics.

Variable	Total	Males	Females	*p*-value
Number of patients	26	14	12	
Mean (SD) age (years)	56 (10.1)	55 (8.1)	57 (12.4)	0.857
Nephrectomy side:				
Right	16	8	8	0.464*
Left	10	6	4	
Mean (SD) BMI (kg/m2)	31 (3.2)	32.1 (3)	29.5 (2.9)	**0.008**
Mean (SD) total operative time (min)	152.3 (37.6)	161.5 (41.1)	141.5 (31.4)	0.501
Mean (SD) estimated blood loss (ml)	90 (67.5)	100 (62)	79.2 (74.5)	0.052
Mean (SD) extraction time (min)	20.4 (5.4)	20.9 (6.8)	19.8 (3.5)	0.938
Mean (SD) specimen weight (grams)	631.5 (323.7)	760.4 (368.5)	481.2 (178.4)	**0.045**
Mean (SD) specimen size (cm)	17.4 (3.9)	18.7 (4.1)	16 (3.1)	0.053
Mean (SD) extraction incision length (cm)	10.7 (2.4)	10.7 (2.2)	10.7 (2.8)	0.836
Mean (SD) recovery room pain score	4.3 (2.1)	4.6 (1.8)	3.9 (2.4)	0.499
Mean (SD) recovery room narcotic use (mg)	15.7 (7.5)	17.5 (6.96)	13.7 (7.94)	0.169

*Fisher's exact test; otherwise, the Mann-Whitney U test.

A *p*-value of less than 0.05 was considered significant for all the tests performed using SPSS statistical software. A correlation analysis was performed using Spearman's rho coefficient to evaluate the association between patient satisfaction with cosmetic and operative results at the first-week, six-week and six-month postoperative visits.

RESULTS

Fourteen male and twelve female non-randomized patients were included in this prospective cohort. The patients' mean age was 56 (40-77) years, and their mean body mass index (BMI) was 31 (27-39) kg/m^2. The BMI was significantly higher in the male than in the female patients (p=0.008).

We performed 26 transperitoneal radical nephrectomies for suspected renal malignancy according to the established procedure; 10 were left-sided, and 16 were right-sided. No intraoperative complications were encountered, and no open conversions were necessary. The final pathological assessment confirmed the diagnosis of renal cell carcinoma in all the extracted specimens, with pathological weights ranging from 190 to 1505 (mean, 631.5) grams and maximum diameters between 9 and 25 (mean, 17.4) cm. Specimens from male patients were significantly heavier (p=0.045) and tended to be larger (p=0.053). The mean total operating time was 152.3 (80-255) minutes, and the mean time required to make the PFN incision, extract the specimen, and close the facial incision was 20.4 (12-35) minutes. The mean incision length was 10.7 (7-16) cm (Table 1).

In the recovery room, the mean pain score was 4.3 (0-8), and the mean narcotic use was 15.7 (0-31) mg of morphine sulfate equivalents.

On the first POD, the mean pain score was 4.4 (1-8), and the mean narcotic use was 33.8 (0-127) mg of morphine sulfate equivalents. Our patients were able to resume fluid intake on the day of operation and normal dietary intake on the second POD (range, 1-4). The mean time until unassisted ambulation was one (0-2) day. The mean total hospital stay was 2.4 (2-4) days (Table 2).

At the one-week postoperative visit, the mean narcotic use was 8.7 (0-60) mg of morphine sulfate equivalents, the mean patient-reported cosmetic satisfaction was 93% (40-100), and the mean overall operative satisfaction rate was 84.4% (30-100). Four postoperative complications were reported at the first-week visit, including 3 superficial wound infections

Table 2 - Postoperative parameters.

Variable	Total	Males	Females	*p*-value
Day one mean (SD) pain score	4.4 (1.5)	4.3 (1.3)	4.5 (1.7)	0.614
Day one mean (SD) narcotic use (mg)	33.8 (28.6)	27.2 (12.6)	45.8 (38.3)	0.226
Mean (SD) time to normal dietary intake (days)	2 (0.6)	1.8 (0.4)	2.4 (0.7)	**0.008**
Mean (SD) time to ambulation (days)	1.1 (0.7)	1.2 (0.6)	1 (0.7)	0.434
Mean (SD) total hospital stay (days)	2.4 (0.6)	2.2 (0.4)	2.6 (0.7)	0.115
One-week visit mean (SD) narcotic use (mg)	8.7 (12.8)	6.1 (7.5)	11.9 (16.9)	0.368
One-week visit mean (SD) cosmetic satisfaction (%)	93 (16.1)	94.3 (16)	91.5 (16.9)	0.192
One-week visit mean (SD) operative satisfaction (%)	84.4 (22.6)	93 (16.1)	74 (25.4)	**0.016**
One-week visit postoperative complications	4	1	3	0.239
Six-week visit mean (SD) cosmetic satisfaction (%)	93 (16.4)	94 (16.1)	91 (17.4)	0.345
Six-week visit mean (SD) operative satisfaction (%)	87.7 (17.7)	87 (19)	88 (17)	0.955
Six-month visit mean (SD) cosmetic satisfaction (%)	97.7 (8.1)	98.6 (3.6)	96.7 (11.5)	0.711
Six-month visit mean (SD) operative satisfaction (%)	98.9 (4.3)	99 (2.7)	98 (5.8)	0.940
Would you choose the same incision type again?				
Yes (%)	24 (92.3)	13 (92.9)	11 (91.7)	0.720*
No (%)	2 (7.7)	1 (7.1)	1 (8.3)	
Would you recommend this type of incision to your family or friends?				
Yes (%)	24 (92.3)	13 (92.9)	11 (91.7)	0.720*
No (%)	2 (7.7)	1 (7.1)	1 (8.3)	0.720*

*Fisher's exact test; otherwise, the Mann-Whitney U test.

Table 3 - Correlation between patient cosmetic and operative satisfaction at different visits.

Visit	Spearman's rho	*p*-value
First-week visit	0.655	0.000
Six-week visit	0.407	0.039
Six-month visit	0.817	0.000

and one case of wound gaping after stitch removal; all the complications occurred in patients with a BMI above 35 (Table 2). No complications or analgesic use were reported at the six-week and six-month visits. In particular, no incisional hernias or keloid formations were encountered. At the last follow-up visits, no cases of tumor recurrence at the operative field or the extraction site were observed. The overall operative and cosmetic satisfaction increased with time post-operation (i.e., 87.7% and 93% at six weeks and 98.9% and 97.7% at six months, respectively) (Table 2). Operative and cosmetic satisfaction strongly and positively correlated with each other at the first-week, six-week and six-month postoperative visits (Table 3). Male patients experienced significantly higher operative satisfaction at the first-week visit (p=0.016), but there were no differences between the sexes at later visits. Additionally, males experienced slightly higher cosmetic satisfaction than females at all the follow-up visits, although this difference was not significant (Table 2).

Patient acceptance of the PFN incision was high. In the quality of life questionnaire, all the patients reported that they would choose the same laparoscopic surgery again, and 92.3% of them would choose the same incision or recommend it to other patients undergoing a similar operation (Table 2).

DISCUSSION

Various incisions are used to access the abdomen. Traditionally, vertical incisions were used for most open abdominal surgeries. Vertical subumbilical midline incisions have the presumed advantages of rapid abdominal entry and less bleeding. Additionally, these incisions may be extended upwards if more space is required for access. The disadvantages of a vertical midline incision include the greater risk of postoperative wound dehiscence and the development of incisional hernia; additionally, the scar is less cosmetically pleasing (13).

The paramedian incision is made to one side of the midline (usually to the right). The anterior rectus sheath is then opened under the skin incision. The belly of the underlying rectus abdominis muscle is then retracted laterally, and the posterior rectus sheath and peritoneum are opened. Because of a shutter-like effect, the stress on the scar is presumed to be less. This incision type has no cosmetic advantage, but the resulting scar is reportedly stronger than a midline scar (14).

The traditional lower abdominal transverse incision was described in 1900 by Pfannenstiel (15). Classically, this non-muscle-splitting incision is located at a breadth of two fingers above the pubic symphysis. The skin may also be entered via a low transverse incision in a natural skin fold that curves gently upward (the 'smile' incision). Compared with vertical incisions, transverse abdominal incisions (including PFN incisions) are associated with less pain, improved cosmesis, and a minimal risk of postoperative disruption (8,13,16,17). The transverse suprapubic scar can be hidden with most types of clothing, including a bathing suit. In addition, the PFN incision is reportedly associated with a decreased rate of incisional hernia (8,16).

Drosdeck et al. (18) performed a multivariate analysis of risk factors for surgical site infection and incisional hernia after laparoscopic colorectal surgery. They found that the use of a PFN extraction site was associated with lower infection rates; however, this association was not statistically significant. Similarly, Samia et al. (19) reported an overall incisional hernia rate of 7% after 480 laparoscopic colorectal surgeries. Of these, midline incisional hernias accounted for 84% of all the hernias. The hernia rates for muscle-splitting, PFN, and ostomy site extractions were 2.3%, 3.8%, and 4.8%, respectively. Orcutt et al. (20) retrospectively analyzed 171 patients who underwent laparoscopic colorectal cancer surgery requiring specimen extraction and/or hand access either through a PFN or a midline incision. Compared with the patients in the midline incision group, those in the PFN group had significantly lower rates of wound disruption (0 vs. 13%, p=0.02), superficial surgical site infection (7 vs. 22%, p=0.03), and overall wound complications (13 vs. 30%, p=0.04).

In our current study, we encountered no bowel complications or incisional hernias. Four postoperative wound complications were observed: three superficial wound infections and one case of wound gaping after stitch removal. These complications were observed in the first week after surgery, and they all occurred in patients with a BMI above 35kg/m^2.

Simforoosh et al. (21) reported their series of fifty patients who underwent mini-laparoscopic live donor nephrectomy. Kidney extraction was performed through a 6- to 8-cm PFN incision. Better cosmetic results were achieved without jeopardizing donor or graft outcome. Gupta et al. (22) compared modified iliac fossa and PFN incisions for kidney retrieval during laparoscopic transperitoneal donor nephrectomy. Although the PFN incision was longer (7.3cm vs. 5.8cm), it was superior in terms of cosmesis. Two patients experienced bladder injury, and one suffered a bowel injury due to the PFN incision.

Cosmetic satisfaction was high in our prospective cohort (Table 2). Male patients were slightly more satisfied with their cosmetic results than female patients at all the follow-up visits ($p>0.05$). The cosmetic satisfaction rate strongly and positively correlated with the overall operative satisfaction rate, and this correlation was stronger at later follow-up visits (highest correlation at the six-month evaluation, Table 3). This finding may be explained by the better resolution and improved elasticity of the scar tissue over time. A high overall operative satisfaction was encountered equally among our male and female patients at the 6-week visit (87.7% ± 17.7) and the 6-month visit (98.9% ± 4.3). However, female patients experienced significantly (p=0.016) less operative satisfaction at the first-week visit, which may be explained by the higher number of wound complications that they encountered at the time of that visit and the slightly, but not significantly (p=0.368), increased requirement for narcotic analgesics.

The PFN incision can be safely used to retrieve large renal specimens, such as polycystic kidneys. We previously reported our experience with laparoscopic transperitoneal nephrectomy for intact specimen extraction in 6 patients with autosomal dominant polycystic kidney disease. The mean pathological kidney size was 22 (16-25) cm, and the mean

incision size was 9 (8-11) cm. No incision-related complications were encountered after one year of follow-up (12). In the current study, the extraction time was acceptable (average, 20 min), and the incision size (mean, 10.7cm) could accommodate large specimens (weight, 1505 grams; maximum length, 25cm). The specimens from male patients were significantly heavier (p=0.045) and tended to be larger (p=0.053) than those from female patients.

We also observed excellent pain control, decreased narcotic use and a short time to full ambulation in our patients who underwent intact renal specimen extraction via a PFN incision. Our patients were able to ambulate without assistance on the first POD as well as to resume fluid intake on the same day of surgery and normal dietary intake on the second POD prior to discharge. During the six-month follow-up, no cases of cancer recurrence were observed at either the operative site or the extraction incision. Patient acceptance of the PFN incision was high, and 92.3% of this cohort would choose the same incision again and would recommend it to other patients undergoing a similar operation.

This study is not without limitations. The limited sample size and the subjective assessment of the cosmetic appearance of scars are the main drawbacks of our study. A validated questionnaire for the objective evaluation of cosmesis should be used in future clinical trials. A prospective randomized comparative study with other extraction sites for laparoscopic radical nephrectomy will provide additional insight regarding outcomes to help surgeons choose the appropriate extraction site for malignant nephrectomy specimens while considering the patient's postoperative quality of life.

Our experience with the PFN incision approach for intact specimen extraction during transperitoneal laparoscopic radical nephrectomy was very positive. This approach provides a good site for intact specimen extraction that heals well with no incisional hernias and results in a cosmetically satisfying scar. A comparative randomized controlled trial with a larger sample size and long-term follow-up will generate more outcome evidence.

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AUTHOR CONTRIBUTIONS

Binsaleh S and Alomar M contributed to the study concept and design, drafted the manuscript, and revised and approved the final version of the manuscript for publication. Madbouly K analyzed and interpreted the data, drafted the manuscript and approved the final version for publication.

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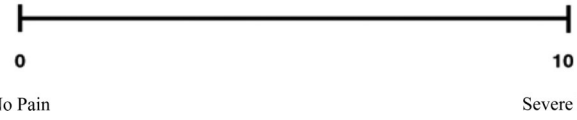
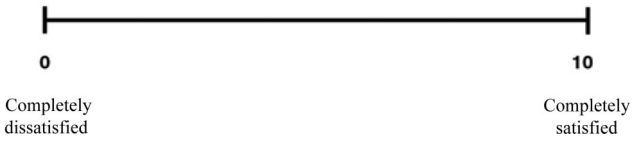
APPENDIX 1 - PATIENT QUESTIONNAIRE AFTER LAPAROSCOPIC SURGERY:

(1) How much pain related to the surgery do you experience now after surgery?

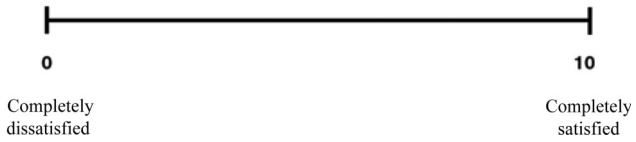
(Mark an X on the line below that best represents your pain level now after surgery)



(2) Overall, how satisfied are you with your operation?
(Mark an X on the line that best represents your level of satisfaction)



(3) Overall, how satisfied are you with the cosmetic result of the operative wound?
(Mark an X on the line that best represents your level of satisfaction)



(4) Would you have the operation again?
Yes ( ) No ( ).
(5) Would you choose the same incision type again?
Yes ( ) No ( ).
(6) Would you recommend this type of incision to your family or friends if they had a similar problem?
Yes ( ) No ( ).