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Laparoscopic Partial Nephrectomy without Using Floseal or Surgicel Bolster: A Case Series with One and Five Year Outcomes

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Abstract

Introduction: Laparoscopic partial nephrectomy is a minimally invasive treatment option for management of renal masses that allows preservation of sufficient renal parenchyma after complete extirpation of the lesion. Various techniques of partial nephrectomy have been in vogue. Amongst the techniques practised for achieving hemostasis, usage of Floseal and surgicel (oxidized cellulose polymer, Ethicon, Johnson and Johnson, USA), bolsters with suturing is the most popular exercise. We bring forth our experience of laparoscopic partial nephrectomy with primary suturing with Lapra-Ty clip anchorage as the hemostatic technique without usage of Floseal or surgicel bolster.

Materials and Methods: All patients were worked up in detail. Cross sectional imaging included a triple phase contrast enhanced computerized tomography (CT scan) or magnetic resonance imaging (MRI) (if preoperative serum creatinine was >1.4 mg/dl). Tumor characteristics were defined using RENAL nephrometry score. Metastatic workup was performed. Non-hilar tumors where >35% of renal parenchyma could be preserved after excision of the tumor were offered laparoscopic partial nephrectomy. All surgeries were conducted following the same technique. Operative and postoperative parameters were recorded in detail. All patients were followed up periodically with clinical assessment, biochemical profile and imaging. Renogram was repeated at 3 months post-procedure.

Results: Between August 2009 till January 2012, 39 laparoscopic partial nephrectomies were performed. Mean age was 52.02 years. 29 were males and 10 females. Mean preoperative serum creatinine was 1.1 mg/dl. Mean longitudinal tumor size was 3.81 cms. Mean RENAL score was 6.56. All procedures could be completed with laparoscopic approach. Mean warm ischemia time was 25.23 minutes. Mean blood loss was 255.77 milliliters. Mean hospital stay was 71.94 h. Positive resection margin was encountered in one case. The cost incurred due to this hemostatic technique was less than the estimated cost of hemostasis if Floseal was used instead. Mean follow-up duration was 65.09 months. All patients were disease free till the last follow-up. No short or long term complications due to this hemostatic technique were encountered.

Conclusion: Our technique of laparoscopic partial nephrectomy is safe, effective and economically advantageous to Floseal usage. Satisfactory renal preservation and appreciable oncological outcome is achieved in short and long term follow-up.

Keywords: Laparoscopy; Partial nephrectomy; Lapra Ty clip

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Introduction

Partial nephrectomy is currently considered as the gold standard treatment option for small renal masses as well as larger exophytic cortical neoplasms where sufficient renal parenchyma can be preserved after complete extirpation of the renal neoplasm [1,2]. Laparoscopic partial nephrectomy clearly outweighs open partial nephrectomy in terms of morbidity profile. The reported oncological outcomes are comparable [3]. Laparoscopic partial nephrectomy is technically demanding and several factors needs to be addressed to ensure a satisfactory outcome. A warm ischemia time well within 20 minutes is desirable, as is achieving a negative surgical margin status. Attainment of satisfactory hemostasis during renorrhaphy also remains an important goal with this procedure. Unaccustomed hemorrhage from the remnant renal parenchyma intraoperatively or postoperatively may lead to further clamping of the renal pedicle for renorrhaphy, thereby prolonging the warm

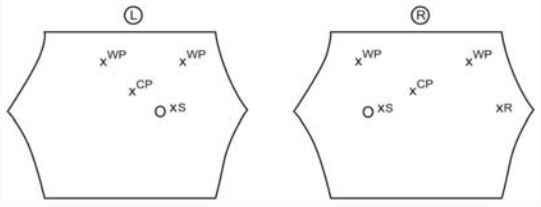

Figure 1: Port positions in left and right laparoscopic partial nephrectomy. **Abbreviations:** WP: Working Port; CP: Camera Port; S-port for placement of laparoscopic Satinsky clamp

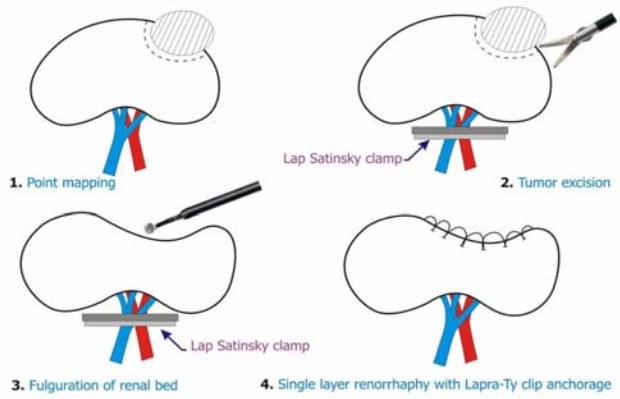

Figure 2: Operative principle stepwise demonstration.

ischemia time or herald extirpation of the remnant renal unit defeating the goal of renal salvage. Several techniques have been investigated for attainment of satisfactory hemostasis in laparoscopic partial nephrectomy [4]. An ideal hemostatic agent should be easily available, easily applicable, cost efficient and effective. Floseal, surgicel bolsters and suturing have been the most commonly employed surgical option to achieve hemostasis [5]. However the usage of Floseal increases the procedural cost and this remains an issue in patients with economic constraints. We narrate our experience in laparoscopic partial nephrectomy with fulguration of the remnant renal bed and renorrhaphy with continuous single layer suturing and Lapra-Ty clip anchorage as the sole method of hemostasis and evaluate its applicability to different tumor locations, procedural safety, economical benefits and oncological efficacy.

Materials and Methods

A prospective study was conducted between August 2009 and January 2012. Patients were worked up in detail including enquiry into presenting complaints, clinical and laboratory assessment. Definitive imaging included triple phase contrast enhanced CT scan abdomen/pelvis (CECT) or magnetic resonance urogram (MRU) if renal profile was altered (serum creatinine >1.4 mg/dl). Tumor characteristics were defined using RENAL nephrometry score [6]. Estimated glomerular filtration rate (eGFR) was calculated using four variable Modification of Diet in Renal Disease equation (eGFR=186 × serum creatinine$^{-1.154}$ × age$^{-0.203}$ × (0.742 if female) × 1.210 if black) [7]. Metastatic work-up was conducted. Patients were planned for laparoscopic partial nephrectomy based on the appearance at cross-sectional imaging. Those with non-hilar tumors where sufficient parenchyma could be salvaged after removing the renal neoplasm (>35% functioning parenchyma), and no contraindication to laparoscopic approach were selected. Patients were placed in lateral decubitus. Transperitoneal approach was followed in all cases. Five ports were used for left sided procedures and six ports for right sided procedures (Figure 1). Technique of laparoscopic partial nephrectomy (Figure 2).

After establishment of pneumoperitoneum, the colon was reflected medially and the renal unit accessed. Dissection was carried out along the plane between renal capsule and Gerotas fascia all around except around the tumor bearing area where a generous cuff of fat was preserved. Renal pedicle was delineated. Laparoscopic Satinsky clamp was then inserted through an additional 10 mm port placed at level of umbilicus. Mannitol (12.5 mg) and frusemide (20 mg) was administered intravenously immediately prior to hilar clamping. Line of resection was mapped using a J hook and electrocautery at least one centimeter beyond the visible tumor extent all around. Renal pedicle was then clamped en masse. Tumor resection was carried out using cold scissors along the pre-demarcated zone. Fulguration of the remnant renal bed and suturing with Lapra-Ty clip anchorage: our hemostatic technique. After complete extirpation of the lesion, the bleeding points in the remnant renal bed were fulgurated using laparoscopic spatula and monopolar cautery. Renorrhaphy was then conducted employing full thickness suturing in a continuous fashion using No 1-0 polyglactin suture. Tension in suture line was maintained by applying sequential Lapra-Ty clips (Ethicon, Cincinnati, Ohio) with a sliding clip technique. In case of caliceal disruptions, no separate calicorrhaphy was performed. No patients underwent ureteric catheterisation or stenting. After completion of suturing, the renal pedicle was unclamped, warm ischemia time noted and the suture line was observed for satisfactory hemostasis. Specimen was entrapped in endocatch bag and retrieved by extending one 10 mm port. Drain placement and port closures are then undertaken. The total procedure duration, blood loss sustained and any significant intraoperative happening were recorded.

Post-procedure

Patients were allowed orally once comfortable. Hematocrit and renal profile was repeated on first postoperative day. Drain and catheter removal was carried out as indicated and patients were sent home once fully ambulatory. Histopathology was assessed at first follow-up about four weeks post-procedure. All patients underwent assessment of renal profile, ultrasound assay and renogram at three months. Further follow-ups were scheduled based on the tumor pathology and current guidelines. Complications were graded as per Clavien-Dindo scale [8]. A computed tomography (CT) or magnetic resonance (MR) angiogram was performed along-with the surveillance imaging at one year and five-year follow-up, to rule out pseudo-aneurysms at renorrhaphy site. Split renal function was repeated at five-year follow-up.

Statistical analysis

Warm ischemia time, operation duration, blood loss, need for blood replacement, postoperative hematocrit, duration of postoperative drainage and percentage change in postoperative eGFR were compared with published series from established centers. Cost comparisons with usage of Floseal (Baxter) were also undertaken. Statistical tests employed included equal variance T test, Aspin Welch unequal variance T test and Wilcoxon-Rank sum test.

Results

Thirtynine patients underwent laparoscopic partial nephrectomy during this period. The demographic profile, tumor characterestics, operative and post-operative parameters are listed in Table 1. Four

Table 1: Demographic profile/ neoplasm characterestics/ operative & post-operative profile.

Parameter	Value, mean ± SD (range)
Age	52.02 ± 13.57 years (34-82 years)
Gender- male: female	27:9
BMI	22.93 ±1.32 kg/m^2 (20.8- 25.2 kg/m^2)
ASA grade	Grade I: 26, Grade II: 10
Pre-operative creatinine	1.10 ± 0.53 mg/dl (0.6-3.2 mg/dl)
Pre-operative eGFR (range)	76.91 ± 25.92 ml/min (20-140 ml/min)
Tumor laterality	Right-14, Left-22
Tumor location	Upper pole-13, Mid pole-6, Lower pole-17
Longitudinal tumor dimension	3.81 ± 1.21 cm (2.9-10 cm)
RENAL Nephrometry score	6.56 ± 1.21 (5-8)
Warm ischemia time	25.23 ± 2.35 (15-29 min)
Blood loss	269.85 ± 65.36 ml (175-450 ml)
Operation duration	202.79 ± 26.49 min (170-265 min)
Day 1 post-operative creatinine	1.43 ± 0.61 mg/dl (0.8-3.8 mg/dl)
Day 1 post-operative eGFR	53.94 ± 15.05 ml/min (17-88 ml/min)
Time to tolerance of orals	12.94 ± 4.12 hours (8-20 hours)
Time to drain removal	45.94 ± 9.36 hours (36-72 hours)
Duration of hospital stay	71.94 ± 9.79 hours (60-96 hours)
Analgesic usage (paracetamol)	1955.88 ± 585.39 mgs (1000-3000 mgs)

Abbreviations: CT:computed Tomography; MRI: Magnetic Resonance Imaging; eGFR-Estimated Glomerular Filtration Rate; ml- milliliters; min-minutes; dl-deciliter; mgs- milligrams; SD-standard deviation.

patients reported deranged renal profile pre-procedure (serum creatinine >1.4 mg/dl). Two patients underwent the procedure on solitary functioning unit. Mean RENAL nephrometry score was 6.56. All patients successfully underwent laparoscopic approach. One patient underwent simultaneous laparoscopic partial nephrectomy and laparoscopic liver segmentectomy for solitary metastatic deposit to segment VII of liver. Another patient with right renal lower pole neoplasm and pancreatic pseudocyst underwent laparoscopic partial nephrectomy and drainage of pancreatic pseudocyst simultaneously. In one patient, persistent bleeding was encountered after vascular unclamping and additional suturing was undertaken. Caliceal disruptions were encountered during tumor resection in six cases in this series and all these patients underwent single layer suturing of the renal parenchyma without separate calicorrhaphy. No other significant operative complications were encountered. One patient required blood replacement. Size of resected specimen ranged from 2.5 × 1.8 cms to 9.0 × 4.7 cms. Mean change in hematocrit was 5.12%. Postoperative complications included Grade II complications in one patient, Grade III complications in one patient, Grade IV complication in one patient and Grade V complication in one patient. One patient required hemodialysis in postoperative period. One patient experienced a cerebrovascular accident involving middle cerebral artery territory on second postoperative day and recovered on conservative approach. No patients experienced any significant urine leak in the postoperative period. No patients revealed any prolonged ileus or persistent post-operative pain. No patients experienced any delayed hemorrhagic episodes during postoperative period. The patient with laparoscopic partial nephrectomy and hepatic segmentectomy succumbed secondary to hepatocellular failure at fifth postoperative day. One patient reported positive surgical margin in pathological assessment. Pathological assessment revealed four angiomyolipomas, one oncocytoma and one chromophobe adenoma and 33 clear cell carcinomas. At three-month follow-up, mean ± SD serum creatinine was 1.14 ± 0.54 mg/dl (range 0.6-3.3 mg/dl). Split renal function of the remnant renal unit at three-month follow-up and five-year follow-up ranged from 30-38%. There was no significant difference between the split renal function in short and long term follow-up. Although a significant rise in creatinine was appraised immediate postoperative (median day one postoperative serum creatinine vs median preoperative serum creatinine- Z value 3.49, p 0.0004, Wilcoxon rank sum test), the difference between preoperative and three-month postoperative creatinine was not statistically significant (Z value 1.55, p 0.12, Wilcoxon rank sum test). Mean ± SD follow-up duration was 65.09 ± 2.67 months (range 60-84 months). All patients completed one year follow-up and 35 patients completed five-year follow-up. Till last follow-up all patients were recurrence free. All patients demonstrated acceptable function of the remnant renal parenchyma. No patients revealed any pseudoaneurysm at suture line in follow-up CT or MR angiogram.

The mean cost incurred for hemostasis in our patients was 1960.20 INR (Indian rupees, average number of Hem-o-loc clips used for Lapra-Ty suturing was 5.94, cost of one cartridge of Hem-o-loc clips containing six clips being 1980 INR) compared to a cost of 12693 INR if we used Floseal in these cases (excluding hospitalization, other consumables and medication charges), p<0.0001, Aspin Welch unequal variance t test.

Discussion

Partial nephrectomy is now the standard of care for single, small (≤ 4 cm), localised renal mass for solitary as well as bilaterally functioning renal units and in patients with compromised renal function [9-12]. The principal benefits of partial nephrectomy are acceptable oncological outcome, decreased risk of chronic renal

insufficiency and more survival advantage [13,14] With increasing familiarity with minimally invasive approaches, partial nephrectomy is increasingly attempted via laparoscopic or robotic assisted laparoscopy approach. The major advantages of these techniques are the excellent morbidity profile and cosmetic benefits. We do not have facilities for robotic approach in our institution. The major concerns for laparoscopic partial nephrectomy are achievement of complete surgical clearance, limitation of warm ischemia time and obtaining satisfactory hemostasis. Due to technical challenges, laparoscopic partial nephrectomy has not been performed universally worldwide till date and more so in the Indian subcontinent [15-17]. Moreover, most centers utilize Floseal and surgicel bolster for achieving hemostasis in laparoscopic partial nephrectomy; thereby the cost of the procedure is increased above the costs incurred due to minimally invasive approach. Our patients belong to low socioeconomic background and minimizing the procedure cost remains an important goal in addition to fulfilling the other goals of minimally invasive approach. We planned to conduct this study with an objective to assess the safety and efficacy of our hemostatic technique and compare the cost of our technique with the cost involved if Floseal was used. Several technical variations for performing a laparoscopic partial nephrectomy have been reported [18-20]. Our technique deviates from the commonly practiced techniques in a number of ways. First, no Floseal or surgicel bolster was used during renorrhaphy. Satisfactory hemostasis was achieved on most occasions. Only one patient (2.56%) experienced additional hemorrhage after pedicle unclamping that was controllable by additional suturing. The mean change in postoperative hematocrit and mean time to drain removal was comparable to published series from established centers [21-24]. Also, no patients experienced any delayed bleeding from the remnant renal bed. Secondly, after tumor resection the remnant renal bed was fulgurated using spatula and electrocautery. Although this theoretically raises the risk of development of pseudo-aneurysm and secondary bleeding in the remnant parenchyma near the suture line, none of our patients demonstrated any abnormality at suture line during short and long term follow-up. Thirdly, irrespective of caliceal disruptions all patients underwent single layer full thickness suturing without any separate caliceal reconstruction. No post-operative urinoma or prolonged urine drainage was remarked and morbidity of additional ureteric catheterization or ureteral stenting could be avoided. Calicorrhaphy is a routine practice in caliceal disruptions in most centers [22]. Our results, though from a small series, definitely questions the undertaking of this exercise routinely. Intracorporeal calicorrhaphy alongwith renorrhaphy prolongs the suturing time. Consequently, the warm ischemia incurred to the remnant renal unit is prolonged. Omitting this step in our technique, helps in limiting the warm ischemia time. The procedure was well tolerated in our patients. In our technique, the operator's proficiency in intracorporeal suturing is a key factor and this influenced the warm ischemia incurred. This technique also has a learning curve. We started using this technique of laparoscopic partial nephrectomy in 2006 and, the mean warm ischemia time in the first ten cases (performed prior to this study) was significantly higher than that recorded in this series (34.56 min vs. 25.23 min, $p<0.001$). Subsequently, with technical modifications and increasing familiarity with the technique, a shorter warm ischemia time could be achieved. The warm ischemia time in our series was slightly more than the desirable warm ischemia time of 20 min. Although there was a worsening in immediate postoperative renal function, no long-term decline in renal function was perceived. Contrary to published citations, [25] none of our patients experienced any acute tubular necrosis in the postoperative period. Apart from surgeon's expertise and learning curve, a few modifications may facilitate in further limiting the warm ischemia in this technique. These include clear demarcation of the line of resection prior to hilar clamping, selecting the optimum length of suture and orienting the axis of renorrhaphy to the most favorable working axis for the operating surgeon. The laparoscopic assistant also needs to be well versed with the exercise. Continuous suction by the assistant to keep the operative field dry and optimum retraction to maintain the axis of suturing is crucial to aid the surgeon in intracorporeal suturing. The location of the lesion also influenced the procedural performance. Lower polar defects were sutured more easily than upper and mid polar defects and anterior based lesions were easier to approach than posterior lesions. The mean operation duration and hospital stay in our series was more than published series from high volume centres [22,24]. We observed our patients as inpatients a little longer to monitor post-operative bleeding from the remnant parenchyma. Cost comparisons with conventional Floseal technique revealed our technique was economically advantageous. In our patients, who are mostly self-funded, this is an important benefit. No additional hemorrhagic complications mandating treatment and adding to the economic burden borne by the patient related to this procedure were encountered post-operatively. Our study has several limitations. Firstly, it is not a randomized controlled study and results need to be validated with larger randomized controlled studies with a control arm using Floseal. This is a single surgeon series and the results of this technique are influenced considerably by the surgeon's skills with laparoscopy and his experience with the procedure. The results from larger multi-institutional studies involving different surgeons with variation in operative skills needs to be assessed. The cost comparison included comparing the cost of hemostatic agents only rather than the complete procedure cost involved. Despite these limitations, our study brings forth the results of a simple technique of performing laparoscopic partial nephrectomy and projects its safety and efficacy in short and long term and hence mention-worthy.

Conclusion

Laparoscopic partial nephrectomy using this technique is safe, effective and economically advantageous to usage of Floseal. Separate calicorrhaphy for caliceal disruptions may be avoided and single layer continuous renorrhaphy maintaining tension may be sufficient. The morbidity sustained to the sufferer is also limited.

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