



Review

Challenging situations in partial nephrectomy



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HIGHLIGHTS

- Thorough planning with the full surgical team is essential before such challenging cases.
- Adequate pre-operative imaging is important to define anomalous anatomy and vasculature
- Whilst multiple techniques may have been reported, it is important for an experienced surgeon to use the approach with which he is most familiar.
- Surgical intervention needs to be carefully considered to balance the oncological safety with maintaining adequate renal function.

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ABSTRACT

Although most partial nephrectomies are performed as primary procedures in the elective or semi-imperative setting on kidneys with relatively normal anatomy, this is not always the case.

The indications for partial nephrectomy continue to expand and it is becoming particularly relevant in patients with single functioning kidneys, poor kidney function, anatomical anomalies and hereditary syndromes predisposing to multiple kidney cancers, such as Von Hippel-Lindau syndrome. These, along with previous abdominal surgery, pose surgical challenges. In this article we offer advice as to how to tackle these unusual situations.

An ability to master the whole range of indications will allow the modern upper renal tract surgeon to offer partial nephrectomy to a wider range of patients.

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1. Challenging situations in partial nephrectomy

The growing detection of asymptomatic small renal masses has resulted in a significant stage migration of RCC [1]. Greater recognition of the importance of preservation of renal function alongside cancer control has further shifted treatment towards nephron sparing techniques. For T1 tumours in healthy patients, partial nephrectomy is now considered the standard treatment. Superior functional and equivalent oncological outcomes mean it is favoured over radical surgery for both T1a and T1b when feasible [2]. The development and increasing use of minimally invasive techniques continue to extend these indications even in those patients previously considered too complex or technically difficult. The key

challenging situations a renal surgeon may face are outlined in this article together with advice on how these particular circumstances should be handled.

2. Prior abdominal surgery

Prior abdominal surgery can present a difficult situation for the robotic surgeon. It has been shown to increase the risk of intra-abdominal adhesions making access difficult or even impossible [3]. Patients need to be consented appropriately and understand the increased risk of conversion to open surgery and injury to vascular or visceral structures in particularly to bowel. Prior abdominal surgery has been shown to be associated with increased operative times and complication rates during laparoscopic surgery [4,5].

Thorough preoperative planning involving the whole surgical team is vital. Understanding exactly what previous surgery was

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performed, the technique and indication is paramount. For example large bowel operations, ruptured appendix and inflammatory bowel diseases are more likely to cause greater adhesions [6].

In difficult cases it is sensible to choose the most experienced nursing staff and assistant for such cases. A reliable, familiar team who understands the intricacies of robotic surgery and can troubleshoot unexpected problems is very important in these situations.

The next step is to decide on which approach to take. A retro-peritoneal approach may be more suited if the patient has had prior intra-peritoneal abdominal surgery, particularly when faced with posterior renal tumours. Its disadvantages are the lack of space and that it is often a less familiar approach for the surgeon. Camera port placement allows the surgeon to assess the amount of adhesions and whether the remaining ports can be inserted safely.

Several techniques can be used to gain access. No device or technique is perfectly safe and there is no consensus regarding the optimal choice, although if in doubt, the open Hassan technique is likely to be safer than a blind Veress needle insertion. If using a Veress needle technique, it should be inserted at a distant site to previous incisions. Optical trocars are not recommended in these situations due to increased risks of bowel injury.

The remaining instrument ports are then triangulated. Knowledge of optimal distances is important to prevent the robotic arms from clashing. Ports need to be at least 8 cm apart and 10–20 cm from the target anatomy when using the da Vinci Si. With the new Da Vinci Xi, ports can be as close as 6 cm. Tapping the skin at the intended insertion site helps the surgeon to visually determine if it is safe to place a trocar. If unsure, a spinal needle can be inserted through the skin and its trajectory can be followed with the camera to ensure there is no interposed bowel. An advantage of the Xi is that the camera can be inserted through any of the robotic ports, allowing the surgeon to visualize the insertion of other ports from different angles. This is particularly useful when placing the assistant ports in the presence of intra-peritoneal adhesions.

Adhesiolysis with laparoscopic scissors may be required to allow safe placement of additional robotic ports after placement of initial trocar. It may be easier to dock one robotic arm first and use the robotic scissors to safely divide adhesions before docking the remaining arms.

A recent study on previous abdominal surgery (PAS) and robotic partial nephrectomy retrospectively analysed 1686 patients who had undergone RPN from an American multi-centre prospective database from 5 large academic institutions [7]. A sub-group of 216 patients (13%) had undergone “major previous abdominal surgery” (PAS); defined as those marked by upper midline or ipsilateral incisions. The list of prior surgeries is wide ranging with 12% (n = 25) having multiple previous procedures and many others having laparotomies, open cholecystectomies and open ipsilateral partial nephrectomies. 11% had a retroperitoneal approach in the PAS group compared with 5.4% in the control arm.

The study found that there was no difference between intra-operative and post-operative complications (<4% Clavien \geq 3 in PAS group), positive surgical margins and change in renal function. Their initial concern that previous surgery increases robotic operative time was ill founded as there was no statistical difference in median operative times (PAS 172mins (132–224) vs no PAS 169mins (139–208)). However, they did find statistical difference in estimated blood loss, which was higher in the PAS group (150 ml vs 100 ml p = 0.039), but this did not translate to a difference in transfusion rates.

They also found the PAS patients were older (median 63 vs 60years) and had a higher median BMI (30.3 vs 29). This is an important finding in the context of offering robotic minimally invasive surgery in an increasingly obese and ageing surgical population.

Another study on transperitoneal robotic partial nephrectomy showed that patients with prior abdominal surgery were more likely to require adhesiolysis (41% vs 15%, P = 0.005). Adhesiolysis took a mean time of 32 min but there was no statistical difference in overall operative time however. In the prior abdominal surgery group, there was a trend toward longer median warm ischaemia time (21 vs 16 min) and median estimated blood loss (150 vs 100 ml), without reaching statistical significance. There was no significant difference in intra or post operative complications [3]. Transperitoneal robotic partial nephrectomy therefore is feasible in the setting of prior abdominal surgery.

3. Single functional kidney

One of the most common challenging situations a renal surgeon will encounter is that of the patient with the single functioning kidney. Close attention needs to be taken to manage the discordant risks of renal cancer and chronic renal failure with its attendant cardiovascular risk and increased mortality [8]. The two primary aims are to achieve adequate tumour resection whilst maintaining sufficient renal function. Chronic kidney disease is encountered in a large proportion of patients with small renal masses [9], but the significantly lower preoperative estimated glomerular filtration rate (eGFR) of patients with solitary kidneys highlights their vulnerability [10]. A single functioning kidney is one of the most significant risk factors for developing renal failure following nephron sparing surgery (NSS) [11].

Partial nephrectomy, despite the risks, is a feasible management option but the factors affecting post operative eGFR remain under debate [10,12–14]. La Rochelle et al. found that the only relevant variables were cold ischaemia time and the presence of cardiovascular risk factors [12]. Furthermore these factors only affected immediate post-operative renal function; none were associated with long-term eGFR. The lack of effect of tumour size was also reported in another single centre study however the authors did show that clamp time and blood loss were significant predictors of post operative eGFR [10]. Again no factors were found to impact the long-term eGFR. Concerns regarding prolonged ischaemia remain valid in the immediate post operative especially in the setting of preoperative renal impairment [15–18]. However large studies have found that in the long term, ultimate renal function is primarily determined by the amount of parenchymal loss not the degree of ischaemia injury [13,16]. After an initial post operative fall in eGFR, studies have shown that long term renal function remains relatively stable following partial nephrectomy [10,12,13]. Thankfully the need long term dialysis remains uncommon [12–14,19]. Those patients with lower preoperative eGFR are at a greater risk of end stage renal disease (ESRD) [12].

Oncological safety is paramount in NSS on solitary kidneys. Given the bleak outcomes for patients on dialysis, avoiding radical nephrectomy is vital [20]. The most significant risk factors to developing ESRD are inadequate resection and local recurrence [13]. Positive surgical margin (PSM) rates have been found to be higher in solitary kidney patients compared to patients with normal contralateral kidneys but its significance is contentious. There is evidence to suggest that PSM have negligible effects on development of metastasis [21] whilst other authors argue that PSM do increase the risk of metastasis [22]. As a result although it is argued that tumour enucleation can offer equivalent outcomes as partial nephrectomy, the balance appears to be moving in favour of performing an adequate resection to minimise the risk of a PSM [23].

Overall NSS in solitary kidneys has been shown to be effective with 5 year cancer specific survival rates of 77.5–95.1% (Table 1). Given survival rates of dialysis patients are less than half, it can be

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