Modern management of small renal masses

BY KARA MCDERMOTT, NICK MEHAN AND BEN CHALLACOMBE

With the advent of widespread cross-sectional imaging there has been a surge in incidental detection of small renal masses (SRMs) and renal cell carcinoma (RCC) is now the seventh most common cancer in the UK. Whilst surgical excision for larger renal tumours remains the standard of care, the management of SRMs (stage T1a defined as <4cm) remains contentious due to the uncertainty about the diagnosis, variable malignant potential and traditional morbidity of treatment. A more nuanced management approach to SRMs is therefore needed to try and maximise oncological control whilst minimising over-treatment. This treatment paradigm continues to evolve with evidence now supporting the efficacy and safety of active surveillance, lesion biopsy, and ablative therapies in well selected patients. In addition, surgical excision in the form of partial nephrectomy (PN) has demonstrated excellent oncological control with maximal renal preservation. Previously limited by procedural and technical factors in the open and laparoscopic era, the proliferation of robotic-assisted surgery has seen an increase in the utilisation of PN for SRMs. There are now over 80 robotic surgeons performing over 1000 procedures across the UK [1].

The role of renal mass biopsy – controversies, limitations and accuracy

Small renal masses are benign approximately 20-30% of the time [2]. The role of biopsy is contentious, however clear reasons to biopsy a renal mass include a single functional kidney, bilateral or multiple tumours, prior to ablative therapy, chronic renal impairment and known other primary cancers (to rule out metastasis). Disadvantages of biopsy include complications of bleeding, infection, tract seeding (rare with modern co-axial needles) and that occasionally, it may be difficult to differentiate certain benign and malignant tumours (e.g. oncocytoma from chromophobe RCC). Papillary tumours with a softer viscous centre are often unrewarding to biopsy with a high chance of inconclusive results and a higher propensity to seed into the perinephric fat than other tumour types.

Patel et al. evaluated the diagnostic accuracy and outcomes of renal biopsy in a meta-analysis of 18 studies. The authors demonstrated renal mass biopsy had a sensitivity of 97.5%, specificity of 96.2%, positive predictive value of 99.8%, negative predictive value of 68.5%, non-diagnostic rate of 14%, and a complication rate of 5% or less [3]. Due to the relatively low risk of complications and due to the morbidity of renal cancer surgery some centres are now routinely performing biopsy on all small renal masses where possible.

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Active surveillance (AS) for small renal masses

Western countries are now treating an increasingly co-morbid ageing population and the management of SRMs need careful consideration in this cohort. Even if malignant, SRMs generally pose a very low annual metastatic potential of 3% or less. They tend to grow at roughly 2-3mm a year and often can be managed with an observational policy with interval ultrasound imaging to record tumour size. In older co-morbid patients, this is often the favoured approach sparing them morbidity of intervention and reserving treatment for very selective cases [4].

AS in younger patients needs very careful consideration, however it is not unreasonable, especially given a significant percentage of these lesions will be benign (up to 40% in patients <40 years of age). The chances of missing the window for treatment is very low and most UK multidisciplinary team (MDT) meetings have large numbers of such patients. Although not standard practice in the UK, several Canadian centres are even monitoring patients with a positive biopsy for malignancy who have lower grade pathology (e.g. grade 1 clear cell, chromophobe RCC) [5]. Whilst certainly not routine, long-term data will no doubt provide further insights into the natural history of these tumours and potentially change the current treatment landscape.

Ablative therapy – advances and ongoing limitations

For patients with smaller tumours who are not fit or suitable for PN, yet warrant treatment, ablative techniques such as cryotherapy and radiofrequency ablation (RFA) are options. These techniques are suitable for tumours up to 3 or sometimes 4cm diameter and ideally away from the hilum, ureter and overlying bowel. Although less invasive and performed as an outpatient procedure, there remains concern over the slightly higher local recurrence rate compared with PN and the difficulty of radiological follow-up with multiple scans being required post-procedure. Definitive studies are lacking in relation to morbidity and long-term oncological outcomes with many failing to recruit.

Nephron sparing surgery for small renal masses

Nephron sparing surgery is currently the standard of care for SRMs where treatment is indicated (EAU Guidelines) [6]. The overarching aim of NSS is excellent oncological outcomes and maximal preservation of renal function. Parenchymal preservation means PN is associated with less postoperative renal impairment and in patients with pre-existing renal dysfunction, PN infers a survival benefit. The trade-off is a slightly higher risk of complications including bleeding, urine leak and the potential for a positive surgical margin. Despite the risk of a positive margin, oncological outcomes of NSS vs. RN are seemingly equivalent.

NSS can be performed open, laparoscopically and increasingly with a robotic-assisted approach [7]. PN is a technically challenging operation with a significant learning curve and variability unrivaled by almost any other frequently performed robotic surgical procedure. The time critical nature of the procedure means efficient excision and renorraphy is essential and the vast renal blood supply makes intraoperative bleeding a significant risk.

The benefits of minimally invasive surgery are clearly established, however technical limitations of laparoscopy have previously prevented the widespread uptake of this technique. Specifically, there have been challenges with accurate tumour excision and suturing techniques leading to higher warm ischaemic times. Many developments have sought to overcome these barriers including the modification of intracorporeal suturing techniques such as the sliding clip renorraphy originally described by Agarwal in 2007. The most significant development however has been the emergence of robotic surgical platforms. Features such as 3D vision, reduction in tremor and articulated instruments have reduced the learning curve associated with excision and renorraphy. Robotics allows a lower warm ischaemia time with <20 minutes being routine whilst providing a clear field for excision under warm ischaemia. Previous high-risk laparoscopic techniques including tumour excision with the harmonic scalpel or equivalent, totally off clamp partial nephrectomy and minimal suturing during renorraphy can usually be avoided with robotics.

Pushing the surgical boundaries

Increasingly, more complex tumours are being managed with PN, with acceptable complication rates [8]. The evidence regarding the safety and efficacy of robotic-assisted partial nephrectomy (RAPN) in patients with ≥T1b tumours, cystic tumours and in patients with single kidneys is increasing. This is partly due to the increased experience of robotic surgeons who are now willing to take on these cases and the improvements being made in surgical technology such as the use of drop-in ultrasound probes (for endophytic tumours) and FireFly ICG technology (for segmental clamping). Preoperative 3D modelling has improved planning and provided surgeons with an enhanced view of the tumour depth, renal vasculature and collecting system. Simulation for PN has rapidly progressed in response to the challenges of training and the availability of PN models is becoming more widespread.

With many new robotic platforms due to come to market we may see other technical improvements that may make these complex surgeries easier for the surgeon and safer for the patient. These highly select cases are best performed in high-volume centres which further supports centralisation of these sub-speciality cases. A recent study [9] has demonstrated reduced transfusion rates and reduced rates of intraoperative and postoperative complications in high-volume centres. With enthusiasm for robotics continuing to grow, it is important to remember there will always be a role for open partial nephrectomy particularly in patients requiring revision surgery, in patients with complex tumours in single kidneys and in patients with genetic renal cell carcinoma (i.e. Von Hippel-Lindau or Birt-Hogg-Dubé syndrome).

Conclusion

SRMs are increasingly common and treating centres need to be able to offer a range of treatment options to be able to provide individualised patient care. Patient and tumour factors need to be carefully considered to maximise oncological outcomes, minimise treatment morbidity, and reduce over-treatment. Active surveillance, partial, or radical nephrectomy form the mainstay of treatment, whilst tumour ablation can be utilised for particular sub-groups. The advent of robotics has substantially progressed the application of PN for SMRs and the boundaries will continue to be pushed as experience with this technique continues to grow.

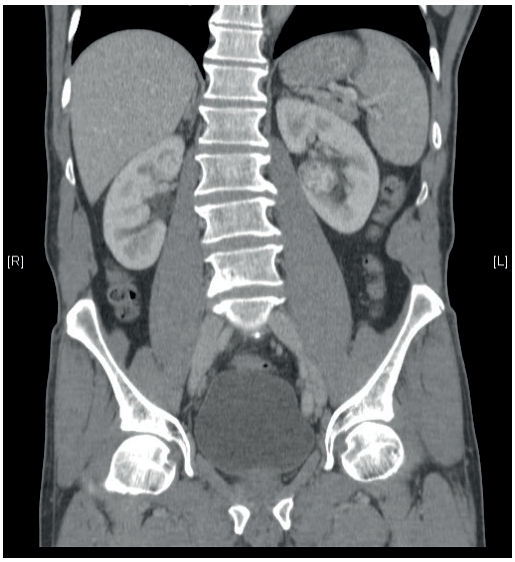

Figure 1: Endophytic left renal tumour removed at robotic partial nephrectomy.

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AUTHORS

Kara Mcdermott,

Uro-oncology Fellow, Guy's Hospital & King's College, London.

Nick Mehan,

Uro-oncology Fellow, Guy's Hospital & King's College, London.

Ben Challacombe,

Consultant Urological Surgeon & Honorary Senior Lecturer; GSTT MDT Urological Cancer Lead; Clinical Robotic Surgery Lead & Fellowship Director; BAUS Oncology Chair; Guy's Hospital & King's College, London.

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