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Challenges of laparoscopic radical nephrectomy at the upper limits of obesity

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ABSTRACT

As worldwide obesity rates increase the number of patients with an elevated BMI requiring urological surgery will increase. Although obesity has previously been considered a relative contra-indication to laparoscopic surgery, here we present a case of successful laparoscopic nephrectomy performed due to renal cancer in a patient with a BMI >60 kg/m^2 together with a review of the associated challenges.

1. Introduction

According to the World Health Organisation in 2022 over 890 million adults worldwide were obese with a body mass index of ≥30 kg/m^2 representing a significant health pandemic.[1] Obesity is a major risk factor for many chronic health conditions such as diabetes, cardiovascular disease and stroke but also malignancy including renal cancer.[1,2] For patients undergoing surgical management for renal malignancy, the American Urology Association and European Association of Urology both support the use of minimally invasive surgery where oncological, functional or peri-operative outcomes are not compromised.[3,4] When laparoscopic surgery was in its early development obesity was considered a relative contraindication for patients requiring nephrectomy due to higher complication rates.[5] As techniques have improved, laparoscopic nephrectomy has been demonstrated to be a safe option for obese patients.[6] In this study we present a case of laparoscopic nephrectomy performed due to renal cancer in a patient with a BMI >60 kg/m^2 together with a discussion of the associated challenges. To our knowledge this the highest BMI reported in current literature for a patient undergoing laparoscopic nephrectomy. Informed patient consent was obtained prior to submission.

2. Case presentation

A 51-year old male was referred for consideration of operative management of an incidental 102 × 47 mm lobulated right renal mass identified on computer tomography (CT) of the abdomen and pelvis (AP) performed in preparation for weight loss surgery. His background was significant for laparoscopic gastric sleeve performed 3 years prior and sigmoid diverticular disease. Following a 3-month weight loss programme with Optifast his weight reduced from 225kg to 215kg. His height was 187cm giving a pre-operative BMI of 61.5 kg/m^2.

Pre-operative investigation was performed with a staging CT Chest, abdomen and pelvis (CT CAP) which demonstrated no metastatic disease and a normal contralateral kidney, Figs. 1 and 2. Full blood count demonstrated a haemoglobin of 164 g/l. Renal function was normal with an eGFR >90 mL/min/1.73m^2. Urine microscopy demonstrated no red blood cells, white blood cells or epithelial cells.

2.1. Surgical technique

The patient was placed right side up with Hasson Port cutdown performed for a 12mm camera port. Instrument ports were placed – a 15mm, 12mm and 5mm port for the liver retraction. Two additional 5mm ports were place – one placed laterally to aid with the lateral dissection and offer elevation of the kidney during hilar dissection, and a second placed lateral to the routine 12mm port to allow further mobilisation of the kidney due to the bariatric instruments bending under the weight of the subcutaneous fat (Figs. 3 and 4). Pneumoperitoneum was established at 12 mm Hg and the ascending colon was mobilised to allow

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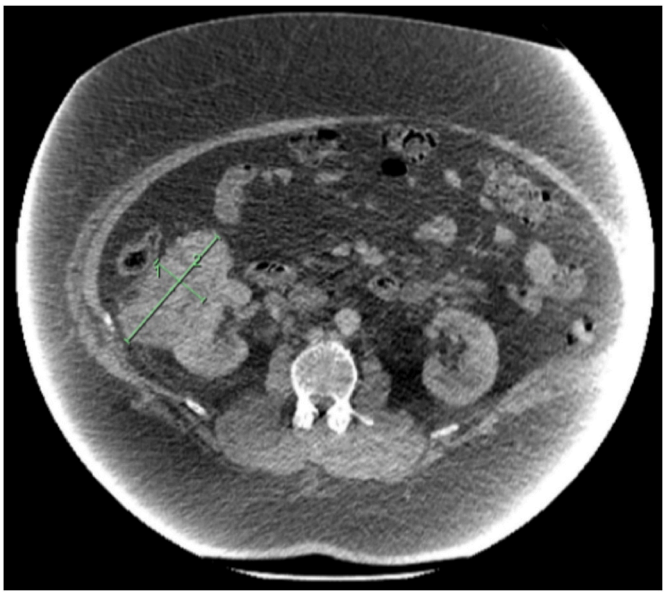

Fig. 1. CTAP of demonstrating left renal mass measuring 10.8 cm by 4.75 cm 6.3 cm, axial.

Fig. 2. CTAP of demonstrating left renal mass measuring 10.8 cm by 4.75 cm 6.3 cm, coronal.

medial reflection and Kocherisation of the duodenum. With exposure of the IVC the right gonadal vein was spared, and ureter identified. The right kidney was mobilised, and the hilar structures identified. There were 2 renal arteries and 1 renal vein which were managed with an Ethicon endovascular stapler while the ureter was clipped and divided using haem-o-lok clips. The ipsilateral adrenal gland was spared. Haemostasis was achieved, and surgical and floseal applied. The kidney was removed via a 15mm endocatch bag and the wounds were closed in layers with no drain utilised. Overall, the operative time was 140mins, and there were no intraoperative complications.

2.2. Anaesthetic technique

The patient was pre-oxygenated in the semi-recumbent position using Hi-flo nasal prong oxygen (THRIVE). Two peripheral cannulas were inserted pre-operatively and monitoring included arterial line for invasive blood pressure, ECG, pulse oximetry, entropy & neuromuscular monitoring.

A modified rapid sequence induction using ketamine, propofol and high dose rocuronium was utilised to minimise time from apnoea to endotracheal intubation and mechanical ventilation. A McGrath videolaryngoscope showed a grade 2 laryngeal view with intubation occurring without technical difficulty.

Anaesthesia was maintained using remifentanil TCI, propofol TCI, low dose desflurane & rocuronium infusion to minimise risk of splinting and atelectasis. Positive pressure ventilation was achieved with Pressure-Controlled Ventilation Volume Guarantee (PCV-VG) 600ml x 10-14bpm with PEEP 10. Inspiratory pressures were measured in the semi-recumbent, recumbent and lateral position and did not exceed 26 mmHg at any stage. Intra-operative analgesia was achieved with paracetamol, parecoxib, low dose ketamine infusion, incremental fentanyl boluses to a total of 500mcg followed by surgically placed TAP infusion of LA at the completion of surgery.

Extubation occurred sitting upright on the patient's bed following recruitment, full reversal with sugammadex and after ensuring patient compliance with deep breathing and ability to follow basic commands.

2.3. Post operative course

Post-operatively the patient was monitored in PACU prior to transferred to ICU for overnight monitoring including pulse oximetry and CPAP compliance. The patient recovered well and was discharged on post-operative day 1. His renal function at discharge demonstrated a slight rise in creatine to 100 μmol/L. Histopathology demonstrated a 70 x 60 × 50 mm interpolar pT3a Clear Cell Renal Cell Carcinoma, Fig. 5. The pathological stage was pT3aNoMo with no nodal involvement, no vascular or renal sinus infiltration however there was evidence of renal capsule penetration. The overall kidney weight was 623g. He remains well with no concerns of recurrence or metastatic disease 2.5 years post operatively.

3. Discussion

Minimally invasive approaches to radical and partial nephrectomy are the gold standard for surgical management of renal cell carcinoma. (3,4) Historically, obesity was considered to be a contraindication for laparoscopic nephrectomy due to increased complications. In 1996, Mendoza et al. reported a markedly higher rate of complications (64 %) in obese patients with median BMI 33.5 while a rate of 34 % was reported by Gill et al., in 1995 for a population undergoing laparoscopic radical nephrectomy for cancer but not stratified by weight.[5,7]

Since this time studies have demonstrated the safety and efficacy of laparoscopic nephrectomy in the obese. A population-based study by Sperling et al. in America found that obesity did not independently predict increased 30-day complications in patients undergoing minimally invasive partial or radical nephrectomy when adjusted for comorbidities.[6] Of note this study did not find a BMI >40 increased the risk of complications other than an increased rate of surgical site infections and discharge requiring skilled nursing input.[6] Further studies by Fugita et al., in 2004 and Arfi et al., in 2014 assessing the impact of obesity on complications in laparoscopic simple or radical nephrectomy supported the view that the obesity should not preclude patients from laparoscopic nephrectomy.[8,9] The study by Fugita et al. did however find there were technical considerations including larger specimens requiring larger incisions with subsequent increased rates of incisional hernia; increased operative time and changes to traditional trocar positioning to account for altered body habitus.[8]

Fig. 3. Positioning for right laparoscopic nephrectomy. Stool placed to provide support for pannus.

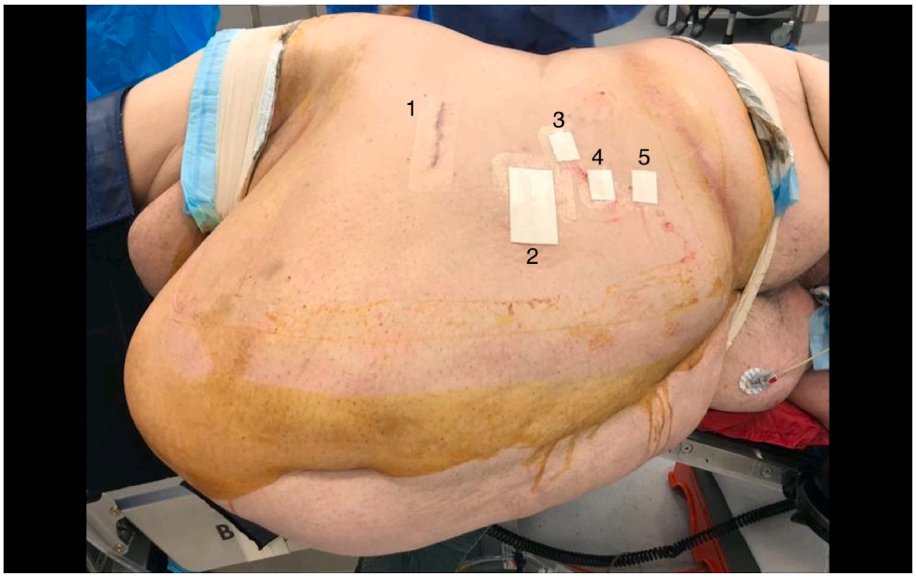

Fig. 4. 1. 15mm instrument port and 5mm additional port to assist with lateral dissection and elevate kidney. Extended to become extraction incision (top edge of incision 5mm port, lower edge 15mm port). 2. 12 mm camera port. 3. 5 mm additional port to support kidney elevation. 4. 12 mm instrument port. 5. 5mm port for liver retraction instrument.

From an oncological perspective, Patel et al. compared outcomes following laparoscopic renal surgery and open renal surgery for patients with T3a renal cell cancer using a propensity matched analysis.[10] This study found that there was no difference in oncological outcomes and recommended the use of laparoscopic surgery where feasible.[10] In keeping with this finding, the EUA recommend that laparoscopic surgery should be offered in preference to open surgery due to lower morbidity again when technically feasible.[4]

Similar to the case report of Malkiewicz et al. and the study by Arfi et al. we found significant consideration was required to optimise the operative approach including manual handling, anaesthesia and operative technique.[8,11]

Given the patients elevated BMI, care was taken to ensure safe manual handling, this included additional personnel and specialised equipment for transfers; a bariatric operating table and use of appropriate restraints and supports to secure the patient including a stool for the abdominal pannus.

Anaesthesia in the obese patient also presents multiple challenges including securing peripheral access[12]; intubation in what are traditionally high-risk patients with reduced safe apnoeic times[13]; management of cardiovascular and pulmonary physiology and unpredictable pharmaco-dynamic/kinetic response to medications.[14,15] Furthermore there is a strong association with metabolic syndrome within the obese population which increases patient risk for perioperative complications

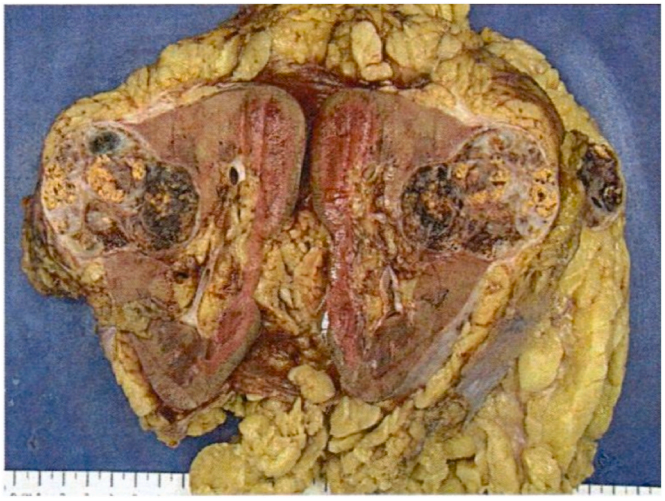

Fig. 5. Macroscopic photograph of tumour. 70x60 × 50mm.

such as thromboembolism.[15] Close peri-operative monitoring is therefore essential to safe anaesthesia in this patient cohort.

In the obese patient modifications are required to the standard laparoscopic nephrectomy technique. When placed in the lateral position, displacement of the pannus leads to a relative shift in anatomical landmarks. Trocar positioning is therefore shifted laterally to allow the required access while also leading to improved visualisation of the target area as internal viscera displaces medially.[9] Additional ports may also be required to facilitate dissection and elevation of the kidney. Due to the weight and depth of subcutaneous fat, bariatric instruments should also be utilised to prevent equipment bending and also to provide the necessary reach from the skin to target area. In contrast to Fugita et al., an increased insufflation pressure was not required to achieve adequate visualisation of the target area in our case.[9]

4. Conclusion

As obesity increases the number of patients with elevated BMI requiring urological surgery will continue to rise. Here we have presented a case of laparoscopic radical nephrectomy in a severely obese patient for the management of a large renal mass and demonstrated it to be both safe and effective with minor modifications to surgical and anaesthetic technique.

CRediT authorship contribution statement

Peter Galloway: Writing – original draft, Writing – review & editing. **Berni Frost:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision. **Avi Raman:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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