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Evaluation of Nephron Sparing Surgery in Adults

ESSAY
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Urology

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Ehab Victor Helmy

Contents

Subject **Page No.**

Review of Literature

List of Figures

Figure **Page No.**

List of Tables

Table **Page No.**

List of Abbreviations

- **ATN** Acute Tubular Necrosis
- **ATP** Adenosine Triphosphate
- **cl-LPN** Clampless Laparoscopic Partial Nephrectomy
- **COX** Cyclo-Oxygenase
- **CT Scan** Computed Tomography Scan
- **GFR** Glomerular Filtration Rate
- **HTK Sol.** Histidine Tryptophan Ketoglutarate Solution
- **IRI** Ischemia / Reperfusion Injury
- **IVC** Inferior Vena Cava
- **KIM-1** Kidney Injury Molecule -1
- **LPN** Laparoscopic Partial Nephrectomy
- **MRI** Magnetic Resonance Imaging
- **NAC** N-Acetyl Cysteine
- **NGAL** Neutrophil Gelactinase-Associated Lipocalin
- **NSS** Nephron Sparing Surgery
- **PN** Partial Nephrectomy
- **PSM** Positive Surgical Margin
- **RAPN** Robotic Assisted Partial Nephrectomy
- **RCC** Renal Cell Carcinoma
- **RN** Radical Nephrectomy
- **ROS** Reactive Oxygen Species
- **SOD** Super Oxide Dismutase
- **UW Sol.** University of Wisconsin Solution
- **WIT** Warm Ischemia Time

Introduction

Introduction

Renal cell carcinoma (RCC) is the third most common genitourinary tumor after prostate cancer and bladder cancer, and it is the seventh most common cancer. It represents about 3% of all malignancies.[1] Men are twice as frequently affected as women, population aged between 50 and 70 years is the most frequently affected. Obesity, hypertension, tobacco smoking and certain occupational exposures have been shown to increase risk for developing RCC.[2]

Among all urological cancers, RCC shows the highest mortality rate, as it affects more than 200,000 people annually worldwide resulting in 102,000 deaths each year.[3]

In the past two decades, significant changes have occurred in the natural history of RCC, because of advances in the knowledge of tumor biology, progress in surgical techniques and due to early detection,[4] since most renal tumors are diagnosed when abdominal ultrasonography or computed tomography are carried out for other medical reasons.[5] However, in the absence of an effective medical therapy, only surgical resection can achieve acceptable results,[6,7] and remains the standard treatment for RCC.

Classically a radical nephrectomy (RN) is performed through an abdominal incision allowing early ligation of the renal artery and vein and removal of the kidney with the adrenal gland within Gerota's fascia.[8]

Nephron sparing surgery (NSS) was originally developed to treat RCC in a solitary functioning kidney where it was done to preserve its remaining function. It has been also demonstrated to be an effective alternative to RN even in the presence of a normal opposite kidney.[9-11]

The international guidelines recommend NSS for small renal tumors up to 4 cm, while the role of NSS for larger renal tumors (stage T1b: 4.1-7 cm, stage T2: >7 cm) remains controversial. Recently the size of the tumor is no longer considered to be a limiting factor for NSS, and some now advocate this procedure whenever possible and feasible.[12] This is attributed to the increasing detection of small renal masses, advances in renal CT and MRI, improved surgical techniques and methods to prevent ischemic renal injury, better post-operative care, and long term cancer-free survival data which have stimulated the expanded use of NSS.[13]

During the last couple of years, data has emerged which demonstrates that NSS can be safely performed with acceptable complication rates compared to RN.[8] The advantage of NSS appears in avoiding the development of end-stage renal disease and the need for haemodialysis, while maintaining quality of life.[14]

Moreover according to the European Association of Urology (EAU) "The current evidence suggests that localized renal cancers are best managed by nephron sparing surgery (partial nephrectomy) rather than by radical nephrectomy".[15]

NSS aims to achieve two goals: complete excision of the tumor and at the same time guarantee an optimal preservation of renal function. With less excision of healthy renal tissue in NSS, we can expect less glomerular injury and renal failure.

Elective NSS provides an optimal result in patients with RCC. Compared to RN, renal parenchyma is preserved without any impact on survival rates. Consequently, elective NSS should be accepted as gold standard management of RCC.[16]

Aim of the Work

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Evaluation of nephron sparing surgery in adults regarding:

- Zonal anatomy of the kidney and its vasculature.
- Indications.
- Preoperative assessment.
- Surgical techniques.
- Warm ischemia, renal hypothermia and its metabolic consequences Complications.
- Oncological results.
- Special hints on the recent modalities in nephron sparing surgery techniques.

Review of Literature

Zonal Anatomy of the Kidney Relevant to Nephron Sparing Surgery

Zonal Anatomy of the Kidney Relevant to Nephron Sparing Surgery

The renal vessels enter the kidney via the renal hilum and from anteroposteriorly; the structures are the renal vein, renal artery, and pelvis.

The renal arteries lie at the level of the second lumbar vertebra below the origin of the superior mesenteric artery. The right renal artery often leaves the aorta at a slightly higher level than the left, and passes behind the inferior vena cava, hence it is longer than the left renal artery.

The main renal artery divides into four or five segmental vessels. The first and the most constant segmental division is the posterior branch which arises from the main stem before it enters the renal hilum, and proceeds posteriorly to the renal pelvis to supply a large posterior segment of the kidney. The remaining anterior division of the main renal artery branches as it enters the renal hilum. Four segmental branches originating from the anterior division are the apical, upper, middle, and lower segmental arteries.

Segmental arteries course through the renal sinus, and branch into interlobar arteries. These interlobar arteries course outwards between the pyramids and branch into arcuate arteries that give rise to multiple interlobular arteries (Figure 1).