NEW TECHNOLOGY IN UROLOGIC SURGERY

An essay submitted for partial fulfillment of the master's degree in urology

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LIST OF ABBREVIATIONS

Abbrev.

AR ....Augmented Reality

bDFS..............Biochemical Disease-Free Survival

CFM...............Confocal Fluorescent Microscopy

CGT ....Germ Cell Tumor

EBL ....Estimated Blood Loss

FDG ٢-١٨F-٢-deoxy-D-glucose

FREDDY ....Frequency-Doubled Double-Pulse

HIFU ....High-Intensity Focused Ultrasound

HoLEP............Holmium Enucleation of the Prostate

HoRBT ....Holmium Resection of Bladder Tumor

LCA................Laparoscopic Cryoablation

LESS...............Laparoendoscopic Single Site Surgery

LNMRI ....Lymphotropic Nanoparticle MRI

LPN................Laparoscopic Partial Nephrectomy

LRFA..............Laparoscopic Radio-Frequency Ablation

MWA............Microwave ablation

NOTES ....Natural Orifice Transluminal Endoscopic Surgery

NVB...............Neuro-Vascular Bundle

OC ....Optical Coherence

PN ....Partial Nephrectomy

PRFA ....Percutaneous Radio-Frequency Ablation

LIST OF ABBREVIATIONS (cont.)

Abbrev.	
RCC	................Renal Cell Carcinoma
RCM	..............Remote Catheter Manipulator
RFA	................Radio-Frequency Ablation
RVS	................Real-time Virtual Sonography
SRMs	.............Small Renal Masses
SRT	................Salvage Radiation Therapy
TRUS	.............TransRectal UltraSonography
TURP	.............TransUrethral Resection of the Prostate
UPJ	................Uretero-Pelvic Junction
USPIO	...........Ultrasmall SuperParamagnetic Iron Oxide

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INTRODUCTION

Technological advances have affected the scope and practice of medicine over centuries. However, the speed and magnitude of technological change over the past few decades are unparalleled in the history of medical science. Urology, which was among the first specialties to innovate, evaluate and incorporate technology, remains so in the twenty-first century.(1)

New technologies have made a significant impact in many areas related to urologic diagnostic and therapeutic procedures. Technologic advances achieved many contributions to the field of urologic surgery such as technological advances in imaging (image-fusion, augmented reality and predictive surgical navigation), molecular imaging, flexible robotics, solid-organ ablation, lasers, nanotechnology, regenerative medicine and others.(1)

Augmented reality (AR) is a novel computer technology for image-guided surgery to display 3-D computer graphics of the surgical space. These are synchronized geometrically and superimposed onto the real endoscopic surgical view, presenting 3-D information of the surgical target beyond the real surgical view. The advantage of this technology is to allow real-time 3-D visualization of the surgical anatomy beyond the endoscopic vision, which it has never been possible to obtain by the human senses alone. It can combine any intraoperatively or preoperatively acquired imaging (including US, CT, MRI, functional MRI, PET, or scintigraphy) and pathological data, and reconstruct them into 3-D computer graphics for surgical navigation. [2]

The use of robotics in urologic surgery has seen exponential growth over the last 5 years. Existing surgical robots operate rigid instruments on the master/slave principle and currently allow extraluminal manipulations and surgical procedures. Flexible robotics is an entirely novel paradigm. Flexible robotics allows the operator to remotely manipulate a flexible endoscope along with flexible instruments passed through the endoscope's working channel to perform delicate tasks.[3]

Another technological advance that caused a paradigm shift in the treatment of urologic cancers is solid-organ ablation. Although the standard of care for most urologic malignancies continues to be surgical extirpation, ablation, in the form of needle-based or extracorporeal approaches, is quickly establishing itself as a viable primary treatment option. If there is anything to be learned from pioneering studies, it is that there must be strict adherence to inclusion criteria for patient enrollment and that there are real limitations with each approach. It is only with this awareness that we can achieve maximal benefit while limiting the number of unnecessary complications and poor oncologic outcomes. [(4)]

Nanomedicine is a new distinct scientific discipline that explores applications of nanoscale materials for various biomedical applications. Translational nanomedicine is undergoing rapid transition from development and evaluation in laboratory animals to clinical practices. In the future, it is anticipated that nanotechnology can provide urologists a new point of view to understand the mechanism of disease, tools for early diagnosis of the disease, and effective modality for treatment.[(5)]

Recently, advances in imaging technology have made possible the ability to image noninvasively specific molecular pathways in vivo that are involved in disease processes. Molecular imaging evaluates changes in cellular physiology and function rather than anatomy, which are likely to be earlier and more sensitive manifestations of disease. In addition, as newer drugs to treat disease become increasingly molecule specific, molecular imaging has become necessary to provide noninvasive determination of patients likely to benefit from treatment and early therapy response.[(6)]

Technology seems to be an integral part of modern living. Urologists have over the years embraced new technological advances for patient benefit. On some occasions, however, the initial enthusiasm in something new has failed to endure rigorous scientific scrutiny. Thus, while being technological leaders, we urologists know better than most other surgical specialties that what is new is not necessarily good.[(7)]