Introduction

The prostate gland is the one of the most important organs belonging to men’s reproductive system that generates the ejaculatory fluid for carrying sperm. Prostate gland is below the bladder and encircles the urethra, which is adjacent to vesicles and rectum. With aging, the prostate will become enlarged with unclear causes, generating the most common disorder known as benign prostatic hyperplasia (BPH). Even though, BPH is non-cancerous, disease can produce dissimilar urinary symptoms, such as frequent urge to urinate, urinary retention and nocturia. Meanwhile, prostate cancer is one of the most common men’s cancer disease affected the entire prostate called diffuse prostate cancer or just a small part of gland called focal prostate cancer. Prostate cancer’s symptoms, unclear in the early stage, are urinary disorder, hematuria, pelvic pain, leg numbness, and erectile dysfunction. The seriousness of the prostate cancer is relied on a combination of the data from the screening tests such as prostate-specific antigen (PSA), rectal examination, and biopsy. If diagnosed early, prostate cancer is possibly curable [1-4].

Focused ultrasound surgery (FUS) under the real-time guidance of magnetic resonance imaging or ultrasound to precisely minimize the damage of non-targeted healthy tissue is a non-invasive method, low-morbidity therapeutic option, radiation-free technique to eradicate ailment prostate tissue. The clinicians manage a beam path of ultrasonic energy to a chose volume of prostate lesion. The energy will heat and eliminate the targeted tissue at the focal spot by elevating the tissue’s temperature up to the threshold of protein denaturation. This process is repeated until the entire selected volume or the entire gland is destroyed. The patient can achieve a short recovery time and a fast return to normal life’s activities with a preservation of significant surrounding organs and sexual function. Food and Drug Administration has recently approved focused ultrasound surgery (FUS) for curing prostate diseases.
prostate cancer and benign prostatic hyperplasia (BPH) [1-4]. There are some FUS machines worldwide used which are divided into two groups with ultrasound guidance (Sonablate, Ablatherm, and Focal one) and with magnetic resonance imaging (MRI) guidance (Tulsa-Pro and Exablate). In this technical review, we aimed to introduce these approaches for prostate cancer and BPH.

**Ultrasound-Guided Transrectal Focused Ultrasound Surgery**

Ultrasound-guided transrectal focused ultrasound surgery was exploited the transrectal FUS probe with low-energy ultrasound of 3-4 MHz for both imaging the prostate and emitting focused ultrasound energy (Figure 1). Computer-controlled positioning system manages the probe and sonication beam path to a specific prostate’s lesion. Under computer control, treatment cells were further overlapped laterally and longitudinally to guarantee that the complete targeted area was comprehensively necrotic. Prior to the treatment, patient was adopted an enema and located in the lithotomy position with spinal anaesthesia. Foley urethral catheter was used to insert during the positioning phase of the treatment so as to expedite the bladder neck, prostatic urethra and seminal colliculus. Normal saline of 50-100mL was dropped into the bladder to clarify the observation of bladder neck and urethra.

![Figure 1: Ultrasound-guided focused ultrasound surgery to the targeted lesion (white arrow). Figure courtesy of Sonocare Medical Inc.](image1)

A condom was used to place over the transducer. The probe was put into the rectum and the covering sheath was dilated with 10-50 mL of degassed water to avoid sonicating through small air and maintain that the rectal temperature of 18-20°C. The probe was wrapped consistently with ultrasonic coupling agent and then embedded into the rectum. Real-time ultrasound was carried out to map the treatment area and surrounding regions. The, the probe was established with the multiarticulated arm in fixed position. The targeted lesion was in the sonication length of 3-4 cm. Prostatic tissue encircling urethra was selected as ablation regions. Longitudinal targeted section should include the total length of prostatic urethra tissues while 7-15 sections were selected in a transversal plane. It is noted that a urethral catheter was used during the imaging phase and removed when therapy was initiated. When the patient position was shifted due to movements or the reflective index in the targeted lesion was abnormally urged, the ablation was contemporarily stopped, the probe need to be repositioned before continuing treatment [5-8].

**MRI-guided Focused Ultrasound Surgery**

Multiparametric MRI is presently the best imaging modality for the diagnosis of prostate diseases. In addition, MRI can be exploited to guide squarely focused ultrasound surgery, helpfulness in both pre-treatment planning and real-time imaging during ablation. MRI is the excellent modality for guidance during ablation allowing high contrast visualization of the targeted lesions and surrounding organs. Real-time MRI thermometry information of the targeted tissue can be obtained during the treatment procedure, which will guarantee biological thermal effects at the focused point. Furthermore, real-time temperature monitoring attenuates the over-sonication risk and undesired damage to the adjacent organs. Finally, contrast-enhanced MRI was consumed to calculate non-vascularized volume of lesions reflected the nonviable tissue region [9-14].

**Transurethral Approach**

MRI-guided transurethral focused ultrasound surgery was carried out under general anesthesia accompanied by insertion of a suprapubic catheter and transurethrally inserted nitinol guidewire. The patient was located in supine position. An austere ultrasound supplicator consisted of a linear array of 10 liberated ultrasound transducer that diffuses directional high-intensity sonication energy directly into the prostatic lesions was placed into the urethra over this guidewire. Computer-aided program was managed to image the targeted prostate margin during treatment planning, control the thermal energy delivery during focused ultrasound ablation, and enforce the accurate temperature feedback algorithm (Figure 2). Under MRI guidance, the ultrasound supplicator was positioned...
Focused ultrasound surgery is a novel non-invasive method for benign prostatic hyperplasia and prostate cancer. There are many approaches of focused ultrasound surgery under the guidance of MRI or ultrasound and the location of treatment transducer inside the rectum or urethra. Each approach for patients with benign prostatic hyperplasia and prostate cancer has advantage and disadvantage mainly based on the guided modalities; hence, further studies should be launched to validate and compare the efficacy and safety of these approaches.
References


