energy, may not confine the treatment to the peripheral zone tissue or to tissues within the prostate.

SUMMARY OF THE DISCLOSURE

[0006] A prostate treatment system is provided, comprising an introducer shaft sized and configured for transurethral access into a patient, a cartridge coupled to the introducer shaft, a vapor generator disposed in the cartridge and configured to generate a condensable vapor, a handle that is detachably attached to the cartridge, the handle comprising actuators to control vapor delivery functions and may be designed to serve both as a handle during insertion of the introducer shaft into the urethra, and a remote control device when the handle is detached and replaced with an introducer shaft stabilizer device, a needle in communication with the vapor generator and slidably disposed within the introducer shaft, a magnet attached to the needle, a solenoid actuator disposed around the magnet, the solenoid actuator providing controlled movements of the needle to deploy into tissue, advance at constant speed or in pulsed steps, and retract into the shaft, sensors disposed on the needle and shaft, an external Trans Rectal Ultrasound System (TRUS) to provide real time images of the prostate during therapy, a Needle Guidance System (NGS) that converts sensor data to needle tip location and heading within tissue and displays this information on TRUS images, and electronics disposed in the cartridge, handle and an external console that communicate with each other and with the user to ensure safe and effective delivery of vapor to targeted tissues and to prevent delivery of vapor outside of targeted tissues.

[0007] In accordance with an aspect of the present disclosure, a prostate treatment system is provided, comprising: an imaging system configured to provide real-time images of a patient's prostate; an introducer shaft sized and configured for transurethral access into the patient; a vapor delivery needle slidably disposed within the introducer shaft, the vapor delivery needle being configured to oscillate so as to enhance visibility of the vapor delivery needle in the real-time images from the imaging system; an advancement mechanism coupled to the therapy needle and configured to advance the vapor delivery needle from the introducer shaft through a prostatic urethra into the patient's prostate; and a balloon disposed on or in the introducer shaft, the balloon being operatively coupled to a supply lumen, wherein rapid inflation and deflation of the balloon is configured to oscillate the vapor delivery needle during vapor delivery.

[0008] In some examples, the system further includes a magnet coupled to the vapor delivery needle, wherein the advancement mechanism comprises a push pull solenoid driver configured to move the magnet to advance and retract the vapor delivery needle.

[0009] In some examples, the solenoid driver is configured to oscillate the vapor delivery needle during vapor delivery.

[0010] In some examples, the system further includes a piezoelectric crystal disposed on or in the introducer shaft, the piezoelectric crystal being electrically coupled to a signal generator and configured to oscillate the vapor delivery needle during vapor delivery.

[0011] In another example the system includes a piezoelectric crystal disposed on or in the vapor delivery needle, the piezoelectric crystal being electrically coupled to a signal generator and configured to oscillate the vapor delivery needle during vapor delivery.

[0012]

[0013] In another example, the system includes a balloon disposed on or in the vapor delivery needle, the balloon being operatively coupled to a supply lumen, wherein rapid inflation and deflation of the balloon is configured to oscillate the vapor delivery needle during vapor delivery.

[0014] In some examples, the system includes a shape memory foil disposed on or in the introducer shaft, the shape memory foil being electrically coupled to a signal generator and configured to oscillate when current from the signal generator is passed through the shape memory foil to oscillate the vapor delivery needle during vapor delivery.

[0015] In one example, the system further includes a shape memory foil disposed on or in the vapor delivery needle, the shape memory foil being electrically coupled to a signal generator and configured to oscillate when current from the signal generator is passed through the shape memory foil to oscillate the vapor delivery needle during vapor delivery.

[0016] In some examples, the system comprises a solenoid coil disposed on or in the introducer shaft, the solenoid coil being configured to strike the introducer shaft or the vapor delivery needle to oscillate the vapor delivery needle during vapor delivery.

[0017] In another example, the system includes a solenoid coil disposed on or in the vapor delivery needle, the solenoid coil being configured to strike the introducer shaft or the vapor delivery needle to oscillate the vapor delivery needle during vapor delivery.

[0018] In some examples, the imaging system comprises a Doppler ultrasound imaging system.

[0019] A method of treating a prostate of a patient is provided, the method comprising: inserting a shaft of a therapy device transurethrally into the patient; advancing a therapy needle from the shaft, through a prostatic urethra of the patient, and into the prostate of the patient; delivering therapy from the therapy needle into the prostate; oscillating the therapy needle; and visualizing the oscillating therapy needle under real-time imaging.

[0020] In some examples, visualizing the oscillating therapy needle further comprises providing real-time Doppler ultrasound images of the oscillating therapy needle.

[0021] In other examples, the delivery therapy further comprises delivery vapor therapy from the therapy needle into the prostate.

[0022] In some examples, advancing the therapy needle from the shaft further comprises actuating a solenoid needle driver that is magnetically coupled to the therapy needle.

[0023] In one example, oscillating the therapy needle further comprises oscillating the therapy needle with the solenoid needle driver.

[0024] In another example, oscillating the therapy needle further comprises vibrating a piezoelectric crystal disposed on or in the shaft with a signal generator.

[0025] In some examples, oscillating the therapy needle further comprises vibrating a piezoelectric crystal disposed on or in the therapy needle with a signal generator.

[0026] In one example, oscillating the therapy needle further comprises rapidly inflating and deflating a balloon disposed on or in the shaft with a signal generator.

[0027] In other examples, oscillating the therapy needle further comprises rapidly inflating and deflating a balloon disposed on or in the therapy needle with a signal generator.

[0028] In some examples, oscillating the therapy needle further comprises vibrating a shape memory foil disposed on or in the shaft with a signal generator.

[0029] In additional examples, oscillating the therapy needle further comprises vibrating a shape memory foil disposed on or in the therapy needle with a signal generator.

[0030] A prostate treatment device is provided, comprising: an introducer shaft sized and configured for transurethral access into the patient; a vapor delivery needle slidably disposed within the introducer shaft; one or more electrodes disposed on the vapor delivery needle; one or more leads electrically connected to the one or more electrodes and configured to run along a length of the vapor delivery needle; an advancement mechanism coupled to the therapy needle and configured to advance the vapor delivery needle from the introducer shaft through a prostatic urethra into the patient’s prostate; and a PCB disposed proximally of the advancement mechanism, the PCB comprising exit holes for the one or more leads and a PCT interconnect configured to electrically couple the one or more leads to a flexible wire lead that extends proximally away from the advancement mechanism.

[0031] In some examples, the one or more leads include slack between where the one or more leads extend from the exit holes and where the one or more leads connect to the PCT interconnect.

[0032] In other examples, the slack is provided in the one or more leads due to differential thermal expansion between the one or more wire leads and the vapor delivery needle during vapor delivery.

[0033] A prostate treatment device is provided, comprising: an introducer shaft sized and configured for transurethral access into the patient; a vapor delivery needle slidably disposed within the introducer shaft; a device body coupled to the introducer shaft and the vapor delivery needle; and a handle comprising one or more controls for operation of the prostate treatment device, wherein the handle is detachable from the device body and configured to control operation of the prostate treatment device when the handle is attached to the device body and when it is detached from the device body.

[0034] In some examples, the handle is configured to control vapor delivery.

[0035] In another example, the handle is configured to control saline delivery.

[0036] In some examples, the handle is configured to control vapor delivery needle advancement and retraction.

[0037] A surgical therapy system is provided, comprising: a patient table; a horizontal adjustment rail; a first stabilizer arm coupled to the horizontal adjustment rail, the first stabilizer arm comprising an unlocked state in which the first stabilizer arm can be adjusted to any desired bend or position and a locked state in which the bend or position of the first stabilizer arm is locked in place, the first stabilizer arm being adjustable axially along the horizontal adjustment rail relative to the patient table; a second stabilizer arm coupled to the horizontal adjustment rail, the second stabilizer arm comprising an unlocked state in which the second stabilizer arm can be adjusted to any desired bend or position and a locked state in which the bend or position of the second stabilizer arm is locked in place the second stabilizer arm being adjustable axially along the horizontal adjustment rail relative to the patient table; an imaging system coupled to the first stabilizer arm; and a therapy system coupled to the second stabilizer arm.

[0038] In some examples, the therapy system comprises a vapor therapy system.

[0039] In other examples, the imaging system comprises a transrectal imaging probe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] To better understand the disclosure and to see how it may be carried out in practice, some preferred examples are next described, by way of non-limiting examples only, with reference to the accompanying drawings, in which like reference characters denote corresponding features consistently throughout similar examples in the attached drawings.

[0041] FIG. 1 shows one example of a vapor delivery system.

CLAIMS:

What is claimed is:

1. A prostate treatment system, comprising:

an imaging system configured to provide real-time images of a patient's prostate;

an introducer shaft sized and configured for transurethral access into the patient;

a vapor delivery needle slidably disposed within the introducer shaft, the vapor delivery needle being configured to oscillate so as to enhance visibility of the vapor delivery needle in the real-time images from the imaging system;

an advancement mechanism coupled to the therapy needle and configured to advance the vapor delivery needle from the introducer shaft through a prostatic urethra into the patient's prostate; and

a balloon disposed on or in the introducer shaft, the balloon being operatively coupled to a supply lumen, wherein rapid inflation and deflation of the balloon is configured to oscillate the vapor delivery needle during vapor delivery.

2. The prostate treatment system of claim 1, wherein the imaging system comprises a Doppler ultrasound imaging system.