Systems and Methods for Neurological traffic and/or Receptor Functional Evaluation and/or Modification

CROSS-REFERENCES TO RELATED APPLICATION

[0001] The present application is ~~an international~~ a national stage of International ~~application~~ Application PCT/US2014/031962 which claims benefit of and priority to U.S. Provisional Application Ser. No. 61/805,523 filed on March 27, 2013, entitled "Systems and Methods for Neurological traffic and/or Receptor Functional Evaluation and/or Modification", by Landy Toth et al., and U.S. Provisional Application Ser. No. 61/885,540 filed on October 2, 2013, entitled "Systems and Methods for Neurological traffic and/or Receptor Functional Evaluation and/or Modification", by Landy Toth et al. the entire contents of which are incorporated by reference herein for all purposes.

BACKGROUND

Technical Field

[0002] The present disclosure relates to the field of surgical modification of neurological function as well as methods for locating, monitoring and/or mapping electrophysiological signals before, during and/or following a stimulus and/or surgical procedure, such as denervation or neuromodulation.

Background

[0003] Congestive heart failure, hypertension, diabetes, sleep apnea, and chronic renal failure have many different initial causes; however, all may include some form of sympathetic hyperactivity. Chemoreceptors, baroreceptors, stretch-receptors, and sympathetic nerves communicate signals with sympathetic centers located in the spinal cord and brain via afferent nerve activity, increasing systemic sympathetic tone; meanwhile, through efferent activity, nerves and arteries participate in sympathetic hyperactivity in response to signals from the brain, further increasing systemic sympathetic tone.

[0007] The above objectives are wholly or partially met by devices, systems, and methods according to the appended claims in accordance with the present disclosure. Features and aspects are set forth in the appended claims, in the following description, and in the annexed drawings in accordance with the present disclosure.

[0008] According to a first aspect there is provided, a guidewire, comprising:

an elongate body dimensioned for insertion into a lumen within a body; and

a sensing tip electrically and mechanically coupled to the elongate body, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with an electrophysiological activity in the vicinity of an anatomical site of interest within the vicinity of the lumen;

wherein the guidewire is configured to monitor the electrophysiological activity.

[0008A] According to a second aspect there is provided, a system for neuromodulating an anatomical site in a vicinity of a lumen, comprising:

a subsystem configured to perform a surgical procedure on the anatomical site;

a guidewire configured to monitor electrophysiological activity within a parenchyma of an organ coupled to the lumen and to generate one or more signals therefrom; and

a control unit configured to accept signals from the guidewire, and to at least one of: adjust the surgical procedure dependent upon the signals; display the signals; evaluate the surgical procedure dependent upon the signals; plan a surgical path dependent upon the signals; and determine the extent of the procedure dependent upon the signals;

wherein the guidewire comprises:

an elongate body dimensioned for insertion into a lumen within a body; and

a sensing tip electrically and mechanically coupled to the elongate body, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with an electrophysiological activity in the vicinity of an anatomical site of interest within the vicinity of the lumen

[0008B] Also disclosed herein is a microsurgical tool for monitoring electrophysiological activity within the vicinity of a lumen, the microsurgical tool including a microfinger in accordance with the present disclosure having a substantially elongate structure configured so as to bias a region thereof against a wall of the lumen upon deployment within the lumen, and a sensing tip in accordance with the present disclosure electrically and mechanically coupled to the microfinger in the vicinity of the region, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with the activity.

[0009] In aspects, one or more of the electrophysiological signals may be related to one or more of water concentration, tone, evoked potential, remote stimulation of nervous activity, an electromyographic signal [EMG], a mechanomyographic signal [MMG], a local field potential, an electroacoustic event, vasodilation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive (e.g. bursts per minute, bursts per heartbeat, etc.), tissue tone, nerve traffic (e.g. post ganglionic nerve traffic in the peroneal nerve, celiac ganglion, superior mesenteric ganglion, aorticorenal ganglion, renal ganglion, and/or related nervous system structures), combinations thereof, or the like.

[0010] In aspects, one or more of the sensing tips may include one or more electrodes, a needle electrode, a force sensor, mechanomyographic (MMG) sensing element, a strain sensor, a compliance sensor, a temperature sensor, combinations thereof, or the like each in accordance with the present disclosure. In aspects, one or more sensing tips may be electrically coupled with a microcircuit, the microcircuit configured to condition the signal.

[0011] In aspects, a system/surgical tool in accordance with the present disclosure may be used to access, monitor, and/or to treat one or more sensory receptors: Ampullae

of a procedure, performing a neuromodulation procedure, denervating a neural structure, combinations thereof, or the like.

[0017] In aspects, a guidewire in accordance with the present disclosure may be sized with a diameter of less than 1mm, less than 0.75mm, less than 0.5mm, less than 0.25mm, etc. In aspects, the guidewire may be configured with a shape set region, configured to bias one or more regions of the guidewire against a wall of a lumen into which it has been placed. In aspects, the guidewire may include a wire basket, a helical region, a balloon, etc. in order to provide such bias against an adjacent lumen wall. In aspects, the shape set region may be retractably collapsible into a delivery sheath (i.e. a sheath provided over the guidewire sized and dimensioned for delivery thereof to an anatomical site of interest). In aspects, the shape set region may be deployed so as to bias against a wall of a lumen into which it is placed by an actuation procedure, retraction of a delivery sheath, protrusion of the guidewire distal tip beyond the distal tip of a delivery sheath, etc.

[0018] In aspects, a guidewire in accordance with the present disclosure may include a bulbous feature located within the vicinity of the distal tip thereof, the bulbous feature configured to bottom out the guidewire within a lumen (e.g. when the lumen diameter approaches that of the bulbous feature, between a step between a feeding lumen and a treatment lumen, etc.). Such a feature may be advantageous to position the distal tip of the guidewire within a treatment lumen (e.g. a vessel, an artery, a vein, a tubule, etc.), to provide hemostasis to the treatment lumen, etc.

[0019] In aspects, a guidewire in accordance with the present disclosure may include a microelectronic circuit embedded within or coupled to the distal tip thereof, as well a coupled to an interconnect and/or controller coupled to the proximal end thereof, configured to control signal flow to/from one or more zones of the guidewire for purposes of performing a procedure in accordance with the present disclosure.

[0020] According to aspects there is provided, a method for treating an anatomical site within a body, including imaging the anatomical site (e.g. with an computed tomography system, high-resolution computed tomography (HRCT), magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), positron emission tomography, ultrasound, optical coherence tomography (OCT), combinations thereof, or

the like) to produce one or more images (e.g. 2D images, 3D images, etc.) thereof, guiding a guidewire, device, and/or aspects of a system in

[00101] In aspects, the tip of the surgical tool may be equipped with an optical microsensor (e.g. a micropackage including a light source and/or a complementary metal-oxide semiconductor (CMOS) photosensor). During a surgical procedure, the optical microsensor may be positioned against or near to the local tissues for analysis before, during and/or after an ablation procedure.

[00102] In aspects, an optically configured sensor (or group of tips) may be configured to locally assess blood perfusion, renin concentration, tissue colorimetric properties, and/or blood oxygenation in the tissues adjacent thereto. The system may be configured to automatically adjust and/or halt the surgical procedure based upon changes (or lack thereof) in this signal. Alternatively, additionally, or in combination, the system may alert a user (e.g. a surgeon, an attendant, etc.) to a change in this signal before, during, and/or after a surgical procedure. Such a configuration may be useful for assessing local tissue health before, during, and/or after a surgical procedure.

[00103] In aspects, one or more optically configured sensor may be configured to monitor for changes in the colorimetric properties of tissues adjacent thereto, such as during an ablation procedure. Such colorimetric property changes may be indicative of a change in tissue state caused by the procedure (e.g. local tissue damage, denervation, etc.).

[00104] In aspects, one or more optical sensors may be configured so as to be biased towards the tissues of the vessel in the vicinity of the surgical site or distally therefrom. The optical sensors may include one or more light sources (e.g. light emitting diodes, fiber optic tips, etc.) configured to delivery narrow, multiband, and/or wideband light to the adjacent tissues. The optical sensors may include one or more photodetectors (e.g. a photodetector, a phototransistor, OCT fiber bundle, a fiber optic tip, etc.) to receive and/or analyze the light reflected from the adjacent tissues. The received light may be related to that emitted by one or more of the light sources, or may be received from an ambient light source, located to the exterior of the vessel, or the exterior of the subject's body.

[00105] In aspects, one or more of the sources may be configured to emit light at predetermined wavelengths such that different absorption characteristics of the adjacent tissues, dependent on the wavelengths, may be observed during the surgical procedure.

determine tone and/or elastic modulus of the tissues of the vessel in the vicinity of the optical sensors. Such a configuration may be advantageous for assessing sympathetic tone and/or vasodilation, vessel wall stiffness, and/or local tissue stiffness before, during and/or after a surgical procedure. Changes in such properties may be indicative of the degree of completion of the surgical procedure.

[00109] In aspects, an externally placed (e.g. onto the body of the subject) energy source (e.g. infrared, near infrared, visible, microwave, radiation, etc.) may be directed into the body towards the surgical site. The energy source may optionally be modulated to provide a more easily detected signal within the subject. One or more optical sensors arrange upon the surgical tool may be configured to sense light emitted from the energy source. The mapping of received light may be used to locate anatomical features such as nerves near to one or more of the optical sensors.

[00110] One or more externally placed light sources may be used to help locate the anatomical sites of interest during the procedure. An external light source may include a narrow band light source, a broad band light source, light sources spaced apart from each other, and/or combinations thereof. The light sources may be modulated so as to be more easily detectable by sensors located in or near to the anatomy of interest. In one non-limiting example, a plurality of light sources may be aimed at the surgical site from distinct vantage points within the body (i.e. as accessed via an endoscopic procedure, etc.) or externally to the body (i.e. as positioned at locations on the body).

[00111] In aspects, an endoscopic camera may be placed near to the anatomy during a procedure to observe both the anatomy, as well as placement of the surgical tools in the vicinity of the anatomy. In one non-limiting example, the endoscopic camera and/or light source may provide a suitable macroelectrode for RF ablation processes performed during the surgical procedure.

[00112] In aspects, one or more optical sensors may be equipped with a corresponding micro-light source (e.g. an organic light-emitting diode (oLED), ~~an~~ light-emitting diode (LED), etc.). The micro-light source may be used to direct light into the adjacent tissues. One or more optical sensors may be configured to detect light emitted from the micro-

light source as back scattered by the adjacent tissues. Such information may be used to detect anatomical features (e.g. nerves, tumors, etc.) in the adjacent tissues.

with the monitoring. Some suitable examples of surgical procedures include RF ablation, Argon plasma coagulation, laser ablation, water jet ablation, ultrasonic ablation, cryoablation, microwave ablation, abrasion, biopsy, delivery of a substance (e.g. a chemical, a drug substance, an acid, a base, a chemotherapy drug, etc.), etc. The local physiologic activity (e.g. nervous activity, blood perfusion, tonal changes, muscular sympathetic nerve activity, local field potentials, etc.) may be monitored with one more sensors and/or associated stimulators. Additionally, alternatively, or in combination, a technique for assessing the properties of an associated surgical site may be employed. Such techniques may include assessing values and/or trends in bioimpedance, blood pressure, tissue oxygenation, tissue carbon dioxide levels, local temperatures and changes thereof, etc.

[00138] In aspects, the system may be configured to deliver a substance such as a therapeutic agent (e.g. a neuroblocking agent, ethyl alcohol, botulinum toxin, etc.) to the anatomical site of interest or a treatment site.

[00139] In aspects, a system in accordance with the present disclosure may include a substrate onto which one or more sensors may be coupled. Such a substrate may be formed from a clamp face, a hook interface, a mesh, an interwoven ribbon array, a cloth, rolled film, etc. The substrate may include stretchable and/or flexible electronic materials.

[00140] In aspects, one or more electrical interconnects may be formed from carbon nanotubes (e.g. single-walled nanotubes (SWNTs), multi-walled nanotubes (MWNTs), etc.), nanowires, carbon fibers, metalized carbon fibers, metallic wires, composites, conductive inks, combinations thereof, or the like.

[00141] A portion, or all of the substrate and/or an associated substrate carrier film may be formed from polyurethane, a silicone, a general elastomer, silk fibroin materials, or the like and/or combinations thereof. Inclusion of microporous or fibrous substrates, may be advantageous to allow the substrate or substrate carrier film to adhere to the adjacent tissues via capillary effects (i.e. tendencies to wick fluid from adjacent tissues into the substrate). The thickness of films formed from the material may be less than

30um thick, less than 20um, less than 10um, less than 4um, less than 1um. Composites of somewhat stiffer materials (such as polyimide, polyethylene terephthalate (PET), polyethylene naphthalate (PEN), etc.) and somewhat softer

[00172] In aspects, the local field potential may be monitored with pass band content preserved at relatively low frequencies in order to determine the near direct current (DC) changes in field potentials caused by the stimulus and/or surgical procedure. Such information may be reflective of changes in local analyte concentrations (i.e. as will affect the local Nernst potential formed by electrodes within the monitoring site), structural changes in the local anatomy (e.g. local tone, water content, low frequency movement, etc.), or the like. Such information may be a suitable surrogate for changes in sympathetic activity and/or neurological connection between the monitoring site and remote yet otherwise connected regions within the body.

[00173] During a surgical procedure, early indication of functional alteration to the nerve structure may be determined by monitoring for a change in the properties of the sensed signal (e.g. a change in latency, amplitude, conduction velocity, spectral content, etc.). In one non-limiting example, an ablation pulse may be applied to the nerve between the stimulatory and monitoring locations. A change in the properties of the sensed signal (e.g. a decrease in high frequency content therefrom, a change in latency, change in amplitude, etc.) may be an early indicator that the ablation pulse is being applied properly to the nervous structure situated there between. In addition, more pulses can be applied and the response monitored in order to observe the nerve response through to a sufficient state of functional alteration, such as desired as part of the neuromodulation procedure.

[00174] Monitoring may continue during a follow up period immediately after the surgical procedure, and/or during a longer term period (e.g. hours, days, weeks, etc.). Such follow up may be used to determine the success of and/or prognosticate on the longevity of the surgical intervention. Such measurements may be advantageous in determining if a surgical procedure was properly applied a seemingly non-responding patient.

[00175] In aspects, the technique may be used to identify the particular neurons of interest ensure that the correct neurons are being treated surgically (as well as to ensure that the extent of the treatment is acceptable). Such identification may involve monitoring a level of neurological activity on the sensed nerve(s) to determine if the

kidney) of a body. The guidewire 100 includes a sensing tip 110 which is positioned within a region 3 (i.e. in this case the renal cortex 3) of the organ 1. A volume 111 defined in the vicinity of the sensing tip 110 may be coupled with the sensing tip 110 during a procedure (e.g. for purposes of monitoring, stimulating, treating, ablating, delivering a substance to, etc. tissues in the vicinity of the volume 111). The guidewire 100 has been inserted endovascularly, percutaneously, etc. into a lumen in the body (e.g. a femoral artery, a femoral vein, a radial artery or vein, etc.) and directed to the monitoring site within the organ 1 shown. In the example shown, the guidewire 100 has been directed along the renal artery 5 (alternatively along a renal vein 7 or a ureter 9, via an aorta 11, a radial access site, a femoral access site, or the like, etc.) such that the tip 110 of the guidewire 100 is placed in intimate contact with one or more electroactive anatomical sites there within. In aspects, the guidewire 100 may be placed such that the tip 110 is oriented within the lumen of a vessel (e.g. an artery, a vein, a ureter, a renal artery, etc.) for obtaining physiologic information therefrom.

[00200] An alternative access point 125 is shown along the ureter ~~125~~ 9, which would provide access to the pelvic wall. In such a situation, the guidewire 100 may be delivered such that one or more sensors located in the tip 110 thereof may interface with the pelvic wall, thus monitoring one or more activities associated with the sensory receptors (i.e. renal mechanosensory nerves) located therein.

[00201] In aspects, a guidewire 100 placed within the renal pelvis may be arranged so as to monitor electrophysiological activity during an associated stimulus event, surgical procedure/event, follow up procedure, stress test, etc. Such events may include a change in renal pelvic pressure (e.g. as induced by a change in posture, introduction of bolus of fluid, altering blood pressure systemically, etc.), introduction of a vasodilator (e.g. bradykinin, etc.), locally to the renal pelvis, inducing a thermal change (e.g. changing a room temperature, introducing a hand into cold or warm water, cooling or warming the blood, etc.), performance of a surgical procedure in accordance with the present disclosure, combinations thereof, or the like. The local electrophysiological response to such stimulus may be an indicator of the health of the kidney, may help to quantify the state of the sympathetic nervous system in the subject, may be used to determine or predict the extent that a subject may respond to a procedure, etc. In aspects, the stimulus

arranged in a single file linear pattern along a predetermined length of the guidewire 100). In aspects, the microcircuit 130 may be encapsulated in a polymer bead, inserted into a protective tube, inserted into the core of a guidewire spring shank, etc.

[00210] In aspects, the microcircuit 130 may be coupled with one or more strengthening members so as to minimize the risk of damage to the coupling between the microcircuit 130 and the sensing tip 110 or the connectors 140. In aspects, the strengthening members may be configured to as to allow for compression, tension, and/or torque transfer through the region of the guidewire 100 that includes the microcircuit 130.

[00211] In aspects, the controller ~~140~~ 120 may include one or more user inputs (e.g. buttons, foot pedals, sliding mechanisms, touch screen displays, etc.) for providing the controller with user guided input so as to adjust signal gain, deploy an aspect of a surgical tool, adjust a stimulation parameter, apply a stimulation, combinations thereof, or the like. In aspects, the controller ~~140~~ 120 may include a display for providing a user with information relating to the physiologic signals, outcome of a procedure, an electrophysiological map, combinations thereof, or the like.

[00212] Fig. 1c shows aspects of methods for using a guidewire 100 in accordance with the present disclosure. Although the methods describe accessing the parenchyma of an organ, they could be equally adapted to measuring electrophysiological activity in vessels within a body (e.g. within arteries, veins, a ureter, a urethra, etc.), for accessing a miniature lumen within the body, etc. A first method 160 for diagnosing a medical condition is described that includes accessing the parenchyma of an organ. By accessing the parenchyma of an organ is meant coupling a sensor or electrode in accordance with the present disclosure with one or more anatomical sites within the parenchyma of an organ, so as to measure one or more physiologic signals therefrom. The first method 160 further includes recording physiologic activity from the parenchyma of the organ (e.g. with a sensor or electrode, a guidewire, a surgical tool, etc. each in accordance with the present disclosure), and monitoring a trend in the physiologic signal (e.g. during a stimulation event, during a stress test, etc.), and/or making a diagnosis or prognosis based upon the recorded signal (e.g. a diagnosis of a disease state associated with local

mapped anatomy, overlaying the present map with previously generated maps (so as to evaluate changes in functionality, activity, etc.), combinations thereof, and the like.

[00216] A fourth method 190 is described including accessing an anatomical site of interest within the parenchyma of an organ, stimulating one or more physiologic systems in the body, and monitoring the evoked response at the anatomical site of interest. The fourth method 190 may include assessing the functionality of the anatomical site of interest, the site of stimulation (i.e. if the stimulation is of a localized type), or an anatomical site there between.

[00217] In aspects, the method may include ablating one or more anatomical sites within the body.

[00218] In aspects, one or more methods in accordance with the present disclosure may be completed, at least in part, with a guidewire 100 in accordance with the present disclosure.

[00219] Fig. 1d shows a schematic of a sensing guidewire 102 in accordance with the present disclosure. The guidewire 102 may include one or more zones such as a sensing tip 112, a sensing/ablation/stimulation zone 114, and/or a second sensing zone 132 each located towards the distal end thereof. One or more of the zones may include aspects for sensing, ablating, stimulating, biasing against adjacent tissues, etc. In aspects, the sensing tip 112 may include one or more sensors and/or electrodes each in accordance with the present disclosure. In aspects, a second zone 114 may be configured to bias 137 one or more aspects of the guidewire 102 against an adjacent lumen wall for purposes of coupling thereto (such as to perform a procedure in accordance with the present disclosure, etc.). In aspects, a third zone 132 is shown, configured so as to interface with an adjacent lumen wall for purposes of sensing, ablation, stimulation, combinations thereof, or the like.

[00220] In aspects, the guidewire 102 may also include one or more connectors 142 in accordance with the present disclosure located at the proximal end thereof. The connectors 142 may be dimensioned and configured to interface with an interconnection module ~~137~~ 138 or a controller 122. Although shown separately, the interconnection

module ~~137~~ 138 and the controller 122 may be integrated into a single unit. In aspects, a system in

accordance with the present disclosure may include both an interconnection module ~~137~~ 138 and a controller 122 coupled together by a cable 147.

[00221] In aspects, the optional interconnection module ~~137~~ 138 may include one or more preamplifiers, multiplexers, switching networks, etc. each in accordance with the present disclosure. Such a configuration may be advantageous to minimize the length of leadwires between the sensing tip 112 and the first signal amplification stage (i.e. a preamplifier in the interconnection module ~~137~~138).

[00222] In aspects, the guidewire 102 may include one or more microcircuits embedded therein (herein embedded within one or more of the zones 112, 114, 132). The microcircuits may be coupled with one or more elements within the sensing tip zone 112 as well as coupled to the connectors 142. The microcircuits may be dimensioned and configured to provide suitable preamplifier functionality, multiplexing operations, digital communication hardware, etc. in order to improve signal integrity from one or more elements within the sensing tip zone 112, to reduce lead wire count, etc. In aspects, the microcircuits may be coupled to elements of the sensing tip zone 112 using an ultra-high density interconnect technology as known in the art and/or in accordance with the present disclosure.

[00223] In aspects, one or more of the zones 112, 114, 132 may be configured so as to interface with an adjacent anatomical feature along which a treatment is desired. Information and/or treatment provided by each zone may be used to determine effective delivery of treatment to a region along the anatomical feature (i.e. physiologic sensing and/or stimulation provided at sites within zones 112, and 132 may be used to determine the effectiveness of a neuromodulation therapy provided to the adjacent tissues in the vicinity of zone 114). In aspects, a therapeutic, stimulatory, and/or sensing configuration may be coupled between zones 112, 114, 132.

[00224] In aspects, one or more steps of a method in accordance with the present disclosure may be performed with one or more zones 112, 114, 132 of a guidewire 102 in accordance with the present disclosure.

[00225] The connectors 142 may be dimensioned and configured to interface with an interconnection module 138 or a controller 122. Although shown separately, the

[00235] Fig. 2d illustrates aspects of a sensing tip of a sensing guidewire 221 in accordance with the present disclosure. The guidewire 221 includes a pushable core ~~223~~ 222 or equivalently a retractable sheath ~~221~~ 223 configured so that the core can be deployed once the guidewire 221 has been directed to an anatomical site of interest. In aspects, one or more of the tip configurations disclosure herein may be attached to the pushable core ~~223~~ 222 in order to construct a sensing guidewire 221 with a deployable 222a tip structure (e.g. with a deployable tip array, a basket arrangement, etc.). The pushable core 222 is also illustrated in a deployed position 224 to illustrate interfacing one or more electrodes there upon with a nearby anatomical site.

[00236] In aspects, the core ~~223~~ 222 may be coupled with a controller 225, preamp, microcircuit, circuit, a connector, or the like each in accordance with the present disclosure.

[00237] Fig. 2e shows aspects of a sensing tip of a guidewire 226 in accordance with the present disclosure. The guidewire 226 includes a microbasket electrode array 227 including an array of micofingers 229, each arranged in a bowed shape so as to extend out from the axis of the lumen into which the device is placed. Aspects of a single microfinger 229 in the array is shown in the detailed view A. The microfinger 229 includes one or more sensors or electrodes 228, each in accordance with the present disclosure. In the example shown in Fig. 2e, the electrode 228 is shown patterned so as to face radially outwards from the center of the lumen into which the sensing tip is deployed. The electrode 228 may be formed in accordance with the present disclosure. One or more regions of the microfinger 229 may be isolated from the surroundings with an insulating layer (e.g. a passivated layer, a dielectric layer, a polymer, PTFE, parylene, etc.). In aspects, the microfinger 229 may be configured so as to deploy to reach the shape shown in Fig. 2e during a predetermined procedure (e.g. actuation, sheath retraction, core extension, biodegradation of a restraint, etc.). In aspects, the microbasket array 227 may be deployed during use so as to interface with the walls of a lumen, in accordance with the present disclosure. One or more microfingers 229 and/or sensors or electrodes 228 may be coupled with a connector or a controller 230, preamp, microcircuit, circuit, a connector, or the like each in accordance with the present disclosure.

[00238] Fig. 2f illustrates aspects of a sensing tip of a sensing guidewire 231 in accordance with the present disclosure. The guidewire generally includes one or more lumens and a microporous tip 232 which includes one or more ports 238 through which one or more protruding microneedle elements 234 may pass upon deployment. The guidewire 231 is shown in a retracted state 236 which may be suitable for accessing a target anatomical site in accordance with the present disclosure, as well as in a deployed state 237 which is suitable for interfacing one or more sensors or electrodes with the target anatomical site as part of a procedure. One or more of the protruding microneedle elements 234 may include a sensor or an electrode on the exposed tip 233 thereof. One or more of the microneedle elements 234 may include one or more features 235 such as bumps, step changes in insulation, etc. configured so as to limit the penetration depth of such exposed tips 233 into the adjacent tissues. One or more aspects of the guidewire 231 or aspects of the exposed tips 233 may be coupled to a controller 239, preamp, microcircuit, circuit, a connector, or the like each in accordance with the present disclosure.

[00239] Fig. 2g shows aspects of a sensing tip of a sensing guidewire 241 in accordance with the present disclosure. The sensing guidewire 241 includes a plurality of deployable tines 242, each tine 242 including one or more sensors and/or electrodes each in accordance with the present disclosure. The deployable tines 242 may be held together during storage and delivery to a surgical site of interest by a restraint mechanism 243 (such as a biodegradable adhesive, a water soluble matrix, a thermally stabilized shape set, etc.). Upon delivery to the anatomical site, upon contact with a fluid, etc. the restraint mechanism 243 may release the tines 242 ~~to~~ so as to deploy 244 them to form a deployed state. In the deployed state, the tines 242 may be significantly biased 247 towards the walls of a lumen into which the sensing tip has been placed, etc. One or more aspects of the guidewire 241 or aspects of the tines 242 may be coupled to a controller 246, preamp, microcircuit, circuit, a connector, or the like each in accordance with the present disclosure.

[00240] Fig. 2h shows aspects of a sensing tip of a sensing guidewire 251 in accordance with the present disclosure. The sensing tip includes one or more microfingers 252 in accordance with the present disclosure. The microfingers 252 shown

2205 for interfacing with the lumen wall 25. The guidewire 2201 may include a soft tip 2207 for assisting with delivery of the guidewire 2201 into the lumen. In aspects, the guidewire 2201 may include one or more electrodes 2209 positioned near to the distal tip of the guidewire 2201 within a biasing zone 2211 in accordance with the present disclosure. The biasing zone 2211 includes a helically shaped region (i.e. such as formed in a shape setting procedure, etc.), so as to bias the electrodes 2209 against the lumen wall 25 upon deployment.

[00248] In aspects, the guidewire 2201 may be configured with a characteristic diameter d, of less than 1.5mm, less than 1mm, less than 0.75mm, less than 0.5mm, less than 0.25mm, or the like. The shape set aspects of the biased zone 2211 may be configured so as to transition from a disconnected region along the lumen wall 25 into a zone of contact, so as to provide consistent contact with the lumen wall 25 during a procedure. In aspects, the guidewire 2201 may be configured so as to transition from a substantially elongate shape to a deployed shape (e.g. a helical electrode arrangement, etc.), upon deployment into the lumen of a vessel within a body.

[00249] In aspects, the guidewire 2201 may be configured for placement within a vessel, for delivery to or within the parenchyma of an organ into which the vessel extends, or the like as part of a surgical procedure. In aspects, the guidewire 2201 may be configured for nerve monitoring, electrophysiological monitoring, stimulation, and/or ablation procedures in accordance with the present disclosure.

[00250] In aspects, the guidewire 2201 may be configured to provide a path, over which a second surgical tool may be delivered to the vessel, the guidewire sensing tip 2205 configured to monitor one or more physiologic functions relevant to the operation and/or evaluation of a procedure performed by the surgical tool.

[00251] In aspects, one or more of the zones 2205, 2211, etc. may be configured for sensing local electrophysiological activity, stimulating local neural anatomy, delivering a substance to local tissues, and/or neuromodulating local neural anatomy (e.g. ablating, denervating, etc.) in accordance with the present disclosure. In aspects, a guidewire in accordance with the present disclosure may include a sensing zone ~~2201~~ 2205 located at the distal tip thereof, an ablating/stimulating zone 2211 located along the length of the

guidewire proximally to the distal tip, and a second sensing zone 132 shown in Fig. 1d located along the length of the guidewire proximally to the ablating/stimulating zone. In aspects, functions performed within each zone 112, 114, and 132 shown in Fig. 1d, 2201, and 2211 shown in Fig. 2l, etc. during a procedure may be coordinated by a controller in accordance with the present disclosure for purposes of diagnosis, determining the extent of a procedure, performing a neuromodulation procedure, denervating a neural structure, combinations thereof, or the like.

[00252] In aspects, the guidewire 2201 may be configured with a shape set region 2211, configured to bias 2213 one or more regions 2211 of the guidewire against a wall of a lumen 25 into which it has been placed. In aspects, the guidewire 2201 may include a wire basket, a helical region, a balloon, etc. in order to provide such bias 2213 against an adjacent lumen wall 25. In aspects, the shape set region 2211 may be retractably collapsible into a delivery sheath (i.e. a sheath provided over the guidewire sized and dimensioned for delivery thereof to an anatomical site of interest). In aspects, the shape set region 2211 may be deployed so as to bias against a wall of a lumen 25 into which it is placed by an actuation procedure, retraction of a delivery sheath, protrusion of the guidewire distal tip beyond the distal tip of a delivery sheath, etc.

[00253] In aspects, the biasing region ~~2211~~ 2213 may be deployed via actuation of an actuator element embedded therein. In aspects, such an actuator element may include an active material transducer in accordance with the present disclosure. In aspects, the actuation may be provided by a shape set shape memory alloy, such as may be introduced into the lumen at a temperature substantially below a threshold transition temperature, and undergo a deployment so as to bias against the lumen wall 25 upon increasing temperature to substantially above the threshold transition temperature (e.g. such as via natural heating from adjacent tissue structures, via active heating, via current flow associated with a stimulation and/or ablation procedure, etc.). In aspects, such deployment may be achieved by other forms of actuation such as but not limited to electroactive material expansion, retraction of a central core, pulling of a tendon core, retraction of a sheath, dissolution of a constraining element, etc.

[00254] In aspects, a guidewire in accordance with the present disclosure may include a bulbous feature located within the vicinity of the distal tip thereof. The bulbous feature

elute a drug into the vicinity of the region during a procedure (e.g. so as to minimize clotting, minimize damage to adjacent structures, etc.).

[00262] In aspects, a guidewire in accordance with the present disclosure may include a thrombus net coupled to the distal tip thereof. The thrombus net may be configured so as to bridge a cross section of a lumen into which the guidewire is placed during a procedure. The thrombus net may be configured to capture debris generated at a site along the system, guidewire, associated catheter, etc. during a procedure in accordance with the present disclosure. The thrombus net may be configured so as to withdraw any captured debris along with the guidewire during withdrawal from the body.

[00263] Fig. 2n illustrates aspects of placement of a delivery catheter 2230 and a guidewire 2240 each in accordance with the present disclosure placed within a body. The delivery catheter 2230 may include a bulbous feature 2236 to assist with placement thereof within a feeder lumen 30 and/or a treatment lumen 35 within the body. The delivery catheter 2230 may include a hollow core to facilitate delivery of an associated guidewire 2240 into the treatment lumen 35. In aspects, the guidewire 2240 may include a plurality of zones, such as a biasing zone 2242 for interfacing one or more electrodes/sensors, and/or a sensing tip zone 2244 with a wall of the target lumen 35. The delivery catheter 2230 and/or the guidewire 2240 may be interconnected with a controller 2232 in accordance with the present disclosure. In aspects, the delivery catheter 2230 may include one or more sensing, stimulation, and/or ablation zones ~~2232~~2234, 2238 in accordance with the present disclosure. In aspects, such a zone 2238 may be coupled to a bulbous feature 2236.

[00264] Fig. 2o shows non-limiting examples of aspects of a feeder lumen 37a,b, a main lumen 39a-d, and a variety of additional lumens 41a-d, which may be considered in the treatment of a disease state, analysis of traffic thereby during a stress test, a diagnostic procedure, a treatment, or the like. Such lumens may be accessed via one or more approaches 49a-c (e.g. via one or more access points into the body, a vascular access point, a venous access point, an arterial access point, etc.). In aspects, the main lumen 39a-d may be interconnected with one or more additional lumens 41a, d. In aspects, the feeder lumen 37a,b may be interconnected with one or more additional lumens 41b, c.

[00265] In aspects, one or more additional lumens 41b,c may not be easily accessed via the main lumen 39a-d. As such, an alternative approach (e.g. via an interconnected lumen, etc.), may be used to deliver a device in accordance with the present disclosure to the additional lumens 41b,c.

[00266] In aspects, a system, device, or method in accordance with the present disclosure may be used to treat a plurality of organs 1a,b, 2a,b (e.g. a kidney 1a,b, a adrenal gland 2a,b). A method in accordance with the present disclosure may include inserting at least a portion of a system or guidewire in accordance with the present disclosure into a main lumen 39a-d, or one or more additional lumens 41a-d and treating one or more regions there within. The method may include monitoring one or more physiologic signals, local electrophysiological signals, etc. to assess completion of the treatment, and/or to determine if further treatment sites are necessary to complete the intended procedure (such as a complete sympathectomy, controlled sympathectomy, etc.). In aspects, a method in accordance with the present disclosure may include withdrawing a portion of a system or guidewire in accordance with the present disclosure from a first lumen 39a-d, 41a-d, and delivering it into an alternative lumen and continuing with a procedure in accordance with the present disclosure.

[00267] In aspects, a method in accordance with the present disclosure may include treating one or more regions within or within the vicinity of one or more additional lumens 41a-d so as to ensure treatment has been completed.

[00268] In aspects, a method for treating hypertension is provided including treating neurological tissues running in the vicinity of a main lumen 39a-d and additional lumen 41a-d so as to substantially denervate all sympathetic and/or parasympathetic nerves coupled with the organ 1a,b, 2a,b. In aspects, the method may include treating the nerves coupled with the adrenal glands 2a,b.

[00269] In aspects, a method in accordance with the present disclosure may include locating one or more additional lumens 41a-d. In aspects, such locating may be performed with an imaging system (e.g. with a computed tomography system, HRCT, MRI, fMRI, positron emission tomography, ultrasound, OCT, combinations thereof, or

ablate the surrounding anatomical sites and then to stimulate/sense with one or more of the proximally oriented electrodes, in conjunction with a sensing/stimulating event at the sensing tip of the guidewire 301. Such information may be used to determine the effectiveness of the ablation procedure, the functionality of the neurological structures between the guidewire 301 sensing tip 303 and the balloon electrodes 311, etc.

[00276] The guidewire 301 and/or the balloon catheter 309 may be coupled with a single controller 305, separate controllers, connectors, etc. so as to perform the intended tasks within the body.

[00277] The guidewire 301 may be configured such that the sensing tip 303 is placed along a region of interest 304 along the delivery route (e.g. such as near to the organ 1, within the parenchyma of the organ 1, along a vessel 5, 7, 9 coupled to the organ 1, etc.). In aspects, an alternative delivery route 312 is shown providing access to the renal pelvis for monitoring, ablation, etc. as part of a procedure in accordance with the present disclosure.

[00278] Fig. 3b illustrates a sensing guidewire 321 in accordance with the present disclosure having been advanced along a lumen 5 within a body to an anatomical site of interest 325 (in this case within the parenchyma of an organ 1). The guidewire 321 includes a sensing tip 323 in accordance with the present disclosure for acquiring one or more physiologic signals from the anatomical site of interest 325 during a procedure (e.g. surgical procedure, diagnostic procedure, signal assessment, etc.). The guidewire 321 may be placed along the path in site 325 shown in order to capture signals relevant to the intended procedure. The guidewire 321 may be used to guide an ablation/ stimulation tool 327 into the lumen 5 so as to properly position it to perform one or more stimulation and/or ablation events along the lumen 5 in accordance with the present disclosure. In aspects, the guidewire may include a stylet core, a stiffened element, etc. over which the second tool 327 may be advanced during placement. Retraction of the stylet may be used to alter the local stiffness of the guidewire 321 thus allowing the second tool 327 to take on a deployed shape (in this case a helical shape). Thus the second tool 327 may be deployed so as to interface one or more electrodes 329, needle delivery ports, included thereupon etc. with the tissues of the lumen wall 5 and the surrounding anatomy. As with

the other coupled devices in accordance with the present disclosure, operation of the guidewire 321 and the second tool 327 may be coordinated so as to elucidate function of the local anatomy, the state of a surgical procedure, completion of a surgical procedure, diagnosis of a functional response to a stress test, etc.

[00279] The guidewire 321 and/or the second tool 327 may be coupled with a single controller 331, separate controllers, etc. so as to perform the intended tasks within the body. In aspects, the second tool 327 may be configured to deliver energy and/or a chemical substance to the adjacent tissues. Such energy delivery may be considered between elements on the second tool 327 or to a remotely coupled element, so as to apply energy radially 326 to, circumferentially 328 around, axially 322 along, the target region, lumen 5, etc. as part of a procedure (e.g. a stimulation procedure, stress test, surgical procedure, etc.).

[00280] The guidewire 321 may be configured such that the sensing tip 323 is placed along a region of interest 325 along the delivery route (such as near to the organ 1, within the parenchyma of the organ 1, along a vessel 5, 7, 9 coupled to the organ 1, etc.). In aspects, an alternative delivery route 324 is shown providing access to the renal pelvis for monitoring, ablation, etc. as part of a procedure in accordance with the present disclosure.

[00281] Fig. 3c shows a sensing guidewire 341 in accordance with the present disclosure having been advanced along a lumen 5 within a body to an anatomical site of interest 344 (in this case within the parenchyma of an organ 1). The guidewire 341 may include one or more sensing tips 343 in accordance with the present disclosure for acquiring one or more physiologic signals from the anatomical site of interest 344 during a procedure (e.g. surgical procedure, diagnostic procedure, signal assessment, etc.). The guidewire 341 has been positioned within the body of a subject and a needle catheter 345 has been directed along the guidewire 341 to a surgical site within the lumen 5. The needle catheter 345 may include one or more delivery needles 347, which may be deployed so as to interface with the anatomy in the vicinity of the lumen wall 5. In aspects, the delivery needles 347 may be hollow so as to administer a substance 350 (e.g. a fluid, a solid powder, or gel, a medicament, etc.) to the anatomy in and around the lumen wall 5. Such medicament ~~345~~ 350 may be configured to alter functionality of the

tissues in the vicinity of the lumen wall 5, to chemically ablate one or more neurological structures, etc. As with the other coupled devices in accordance with the present disclosure, operation of the guidewire 341 and the needle catheter 345 may be coordinated so as to elucidate function of the local anatomy, the state of a surgical procedure, extent of an ablation process, etc.

[00282] In aspects, the guidewire 341 may be left in place and the needle catheter 345 removed after delivery of the bolus of substance 350 to the walls of the lumen 5. After removal of the needle catheter 345, the guidewire 341 may be used to monitor for a prolonged period of time in order to identify if the substance 350 was properly delivered to the intended tissues (i.e. to determine if the neurological function returns after the intervention, or if the change in function has been relatively permanent in scope).

[00283] In aspects, the needle catheter 345 may include features 351 so as to limit the depth with which the delivery needles 347 may enter into the lumen wall 5 during deployment, as well as to gauge the depth at which a medicament ~~351~~ 350 is delivered into the tissues. In aspects, the needle catheter 345 may include a plurality of delivery needles 347 so as to both stabilize the catheter 345 as well as to deliver medicament 351 to a plurality of locations within the adjacent tissues.

[00284] In aspects, the delivery needles 347 may include one or more electrodes 349 configured for stimulation, ablation, and/or sensing with each function being suitable for coordinating with the guidewire 341 during an interventional procedure.

[00285] The guidewire 341 and/or the needle catheter 345 may be coupled with a single controller 353, separate controllers, connectors, etc. so as to perform the intended tasks within the body.

[00286] The guidewire 341 may be configured such that the sensing tip 343 is placed along a region of interest 344 along the delivery route (such as near to the organ 1, within the parenchyma of the organ 1, along a vessel 5, 7, 9 coupled to the organ 1, etc.). In aspects, an alternative delivery route 342 is shown providing access to the renal pelvis for monitoring, ablation, etc. as part of a procedure in accordance with the present disclosure.

[00287] Fig. 3d shows a sensing guidewire 361 in accordance with the present disclosure having been advanced along a lumen 5 within a body to an anatomical site of interest 364 (in this case within the parenchyma of an organ 1). The guidewire 361 may include one or more sensing tips 363 in accordance with the present disclosure for acquiring one or more physiologic signals from the anatomical site of interest 364 during a procedure (e.g. surgical procedure, diagnostic procedure, signal assessment, etc.). The guidewire 361 has been positioned within the body of a subject and an ultrasound catheter 365 has been directed along the guidewire 361 to a surgical site within the lumen 5.

[00288] The ultrasound catheter 361, may include a balloon (as shown) or an energy directing element, configured so as to delivery and/or direct the delivery of ultrasonic energy 367 to one or more tissue sites surrounding the lumen 5 during a surgical procedure. In aspects, such ultrasonic energy 367 may be used to disrupt the regular neurological traffic there along, and/or to ablate the neurological anatomy located in the vicinity of the lumen 5.

[00289] In aspects, the ultrasound catheter 365 may include one or more electrodes configured for stimulation, ablation, and/or sensing with each function being suitable for coordinating with the guidewire 361 during an interventional procedure.

[00290] The guidewire 361 and/or the ultrasound catheter 365 may be coupled with a single controller 370, separate controllers, connectors, etc. so as to perform the intended tasks within the body.

[00291] As with the other coupled devices in accordance with the present disclosure, operation of the guidewire 361 and the ultrasound catheter 365 may be coordinated so as to elucidate function of the local anatomy, the state of a surgical procedure, extent of an ablation process, etc.

[00292] The guidewire 361 may be configured such that the sensing tip 363 is placed along a region of interest 364 along the delivery route (such as near to the organ 1, within the parenchyma of the organ 1, along a vessel 5, 7, 9 coupled to the organ 1, etc.). In aspects, an alternative delivery route 362 is shown providing access to the renal pelvis for monitoring, ablation, etc. as part of a procedure in accordance with the present disclosure.

silver, gold, spring steel, etc.). In aspects, the core 511 may be dimensioned with a diameter 515 of less than 25um, less than 12um, less than 7um, less than 5um, less than 2um, etc. In aspects, one or more segments of the core 511 may be covered with a clad layer 512. The clad layer 512 may include a passivating material, a highly conducting material, a bioactive material, etc. configured so as to isolate the core 511 from the surroundings, to improve the longitudinal conductivity of the core 511 (i.e. in the case of a metallic clad layer 512), provide unique analyte identification means (i.e. in the case of a bioactive clad layer 512, an enzymatic layer, etc.). In aspects, the clad layer 512 may result in a clad diameter 516 of less than 100um, less than 25um, less than 12um, less than 6um, less than 4um, etc. In aspects, the clad layer ~~511~~ 512 may be thinner than 1um, thinner than 0.5um, thinner than 0.1um, etc. In aspects, the clad layer ~~511~~ 512 may provide improved optical transmission down an optically oriented fiber 503.

[00312] In aspects, one or more segments of the clad layer 512 or the core 511 may be coated with an insulating layer 513. The insulating layer 513 may include a dielectric material, a thick walled polymer material, a ceramic, etc. The insulating layer 513 may be configured to enhance electrical isolation and/or reduce cross talk between fibers 503 over segments of the guidewire 501. In aspects, the insulating layer 513 may have a diameter 517 of less than 200um, less than 100um, less than 50um, less than 25um, less than 10um, etc. In aspects, the insulating layer 513 may be provided with differing thickness (i.e. different overall fiber diameter 517) along alternative segments thereof. In one non limiting example, the insulating layer 513 is relatively thin near to the distal region of the guidewire 501 but increases in thickness in the proximal direction thereof.

[00313] In aspects, the clad layer ~~511~~ 512 and/or the insulating layer 513 may be removed and/or otherwise not present over one or more segments of the fiber 503. Such a configuration may be advantageous for altering the flexibility, altering the intercommunication of the fibers 503, allow for interconnects between fibers 503, etc. over a particular segment of the guidewire 501.

[00314] In aspects, the clad layer 512, and/or the insulating layer 513 may be applied electrochemically to the core 511. In aspects, one or more of the layers 512, 513 may be applied via electrodeposition, a self-assembly process, a cataphoretic process, etc. In

aspects, such a process may be used to form a highly uniform layer 512, 513 on the core 511.

[00315] Fig. 5c shows aspects of a bundle of fibers 503 in accordance with the present disclosure configured near to the wall of the jacket 505 of the guidewire 501 in accordance with the present disclosure. A detailed image B is shown to highlight the arrangement within the guidewire. In aspects, such a configuration may provide for a highly flexible guidewire 501 including hundreds to thousands of fibers 503 for interfacing with the anatomical site of interest while maintaining an overall diameter and flexibility that allows for access to small vessels within a body (e.g. access into an organ parenchyma, small arteries, veins, large arterioles, large venules, etc.).

[00316] In aspects, the packing density of the fibers 503 may be provided so as to more easily interface with the fibers 503 near to the proximal end of the guidewire 501.

[00317] Fig. 5d shows aspects of a deployment mechanism for a fiber guidewire 521. The fiber guidewire 521 may include one or more fibers 523 and/or a jacket 525 each in accordance with the present disclosure. The fibers 523 may be configured into a bundle, representing the interior aspects of the guidewire 521. The jacket 525 may help to insulate and/or shield the fibers 523 from the surroundings during placement within a body. In aspects, the guidewire 521 and fibers 523 may be coupled with a connector, a microcircuit, a preamplifier, and/or a controller 529 in accordance with the present disclosure.

[00318] In aspects, the fibers 523 or a segment there along may be bonded together with temporarily restraining matrix 527 (e.g. a biodegradable matrix, an electrochemically degradable matrix, a water soluble matrix, etc.). Such a configuration may be advantageous for assisting with deployment 533 of the fibers 523 once the guidewire 521 has been placed near to the anatomical site of interest. Alternatively, additionally, or in combination, the jacket may be dimensioned and configured so as to be retractable for deployment of the fibers after placement (i.e. retractable so as to expose the fibers after delivery to the site of interest).

[00319] In aspects, the restraining matrix 527 may include a bolus of a stressing medicament (e.g. a neurostimulant, a neurodepressant, a vasodilator, a vasoconstrictor, a

neuroblocking agent, glucose, insulin, etc.). In aspects, the bolus may be delivered into the organ 1 of the subject while the guidewire 521 monitors the associated physiologic response thereto at the site of interest.

[00320] Figs. 6a-e show aspects of flexible multi-electrode guidewire tips 601a,b, 621, 661 in accordance with the present disclosure. Fig. 6a shows monolithic guidewire tips 601a,b including one or more tines 603a,b, each tine including one or more sensors and/or microelectrodes 605a,b each in accordance with the present disclosure configured for interfacing with an anatomical site of interest within a body. The guidewire tip 601a,b may be at least partially formed from a flexible substrate 607a,b in accordance with the present disclosure configured and dimensioned to form tines as well as provide electrical interconnection of components placed there upon, or integrated into the substrate 607a,b.

[00321] In aspects, the substrate 607a,b may include a flexible polymer, polyimide, PET, PEN, an elastic material, a silicone, an elastomer, an electroactive polymer, or the like known in the field of flexible electronics.

[00322] In aspects, the guidewire tip 601a,b may include one or more microcircuits 611a,b in accordance with the present disclosure. The microcircuits 611a,b may be configured to perform one or more functions such as signal routing, multiplexing, demultiplexing, preamplification, signal amplification, filtering processes, differential coupling to a reference electrode, signal conditioning function, analog to digital conversion, communication, power management, combinations thereof, and the like. The substrate 607a,b may include one or more conducting traces 609a,b placed so as to interconnect the sensors and/or electrodes 605a,b with the microcircuits 611a,b.

[00323] In aspects, one or more of the conducting traces 609a,b may include a metal, a meandering metal trace (i.e. so as to improve the flexibility or stretch capability thereof), an organic conductor, a printed structure, a physically deposited structure, or the like.

[00324] In aspects, one or more microelectrodes 605b may be formed at the extreme tip of a tine 603b. Such formation may be achieved by routing one or more traces 609b to the tip and severing the tip so as to expose only the most distal part of the trace 609b so as to form the interconnect for the microelectrode 605b. The interconnect may be plated

with an interfacing material, such as a metal, platinum, a composite, a conjugated polymer, etc. so as to form the microelectrode ~~650b~~ 605b and so as to enhance coupled between the microelectrode ~~650b~~ 605b and a surrounding anatomical site of interest.

[00325] The substrate 607a,b may include interconnects for coupling with power and signal lead wires 613a,b. The microcircuit 611a-b may be configured to communicate with an outside communication module, a controller, or the like (not explicitly shown). In aspects, communication may be in the form of a bus protocol such as I^2C, 1-wire, SPI, serial, etc. In aspects, the lead wires 613a,b may be configured and interconnected to power management hardware configured so as to provide power and signal communication along the same leads. Such a configuration may be advantageous to minimize the number of lead wires 613a,b within the guidewire.

[00326] After attachment of components (e.g. sensors, microcircuit(s) 611a,b, lead wires 613a,b, etc.) the substrate 607a,b may be rolled 615 to form a completed guidewire tip 617. Fig. 6b shows a completed guidewire tip 617 with an integrated jacket 619 coupled to the tip so as to reinforce the electrical interconnection of the substrate 607a,b, the lead wires 613a,b, and/or the microcircuits 611a,b. In aspects, the jacket 619 may also provide increased electrical isolation between the microcircuits 611a,b, the traces 609a,b, the lead wire 607a,b interconnects, and the surroundings.

[00327] Fig. 6c illustrates a non-limiting example of a guidewire tip 621 with deployable tines 603. The tines 603 may be deployed from within a jacket 623 by retraction 625 of the jacket 623, advancement 627 of the tines 603 or a combination thereof. Such action will lead to deployment 629 of the tines 603 so as to monitor a physiologic parameter during a procedure in accordance with the present disclosure.

[00328] Two non-limiting examples of deployed configurations are shown in Fig. 6c, a configuration where the tips of the tines 603 are free and the set shape of the tines 603 results in a flower like formation upon deployment from the jacket 623. In aspects, the interconnects 631 on the substrate 607 may be dimensioned and/or encapsulated so as to form a soft seal against the jacket 623. Such a configuration may be advantageous to minimize fluid ingress to the guidewire during a procedure.

[00329] In aspects, the lead wires 6~~1~~03 may be coupled with a controller 630 in accordance with the present disclosure.

[00330] Another example of a deployed configuration is shown in Fig. 6c, a configuration where the tips of the tines 603 are held together with a restraining tip 635 so as to form a basket shape upon deployment 625. The basket may be retained in a jacket 639 of the device before deployment 625. In aspects, the restraining tip 635 may include an additional pull wire 632 configured such that relative movement of the pull wire may provide the forces necessary to deploy 625 the tines 603 (i.e. to convert the tines 603 from a collapsed shape to a basket-like shape).

[00331] In aspects, one or more of the tines 603 may be coupled with a microcircuit 637 in accordance with the present disclosure. The microcircuit 637 may be embedded into the device substantially near to the tines 603, within 400mm thereof, 100mm thereof, within 20mm thereof, within 5mm thereof, etc.

[00332] Fig. 6d illustrates a close up view of a tine 603 in accordance with the present disclosure. The tine 603 includes a plurality of electrodes 605 arranged along the tine 603 with a predetermined spacing 642. The tine 603 is constructed with a predetermined width 641, which may be tapered and/or otherwise shaped along the length of the tine 603. The tine 603 may include one or more traces 609 to interconnect the electrodes 605 with one or more microcircuits. The tine 603 may be generally constructed from a substrate 607 in accordance with the present disclosure. In aspects, the substrate 607 may be constructed from a laminate composite structure, including a base substrate, the traces, overcoats, etc. In aspects, the electrodes 605 may be configured so as to extend beyond the height of the substrate 607 such as by forming the electrodes 605 as bumps, generating whisker like features on the electrodes 605, plating the electrodes 605, etc.

[00333] Fig. 6e shows aspects of a guidewire tip ~~611~~661 in an unraveled and a wrapped configuration. In the unraveled configuration the guidewire tip ~~611~~661 may include one or more tines 651 formed from a substrate 652 shaped so as to form a tine envelope 655. One or more components on the tines interconnected with one or more chipset(s) 653 located at the root of the substrate 652. In aspects, the rolling process 657

may be used to arrange the tines 651 into a completed guidewire tip ~~611~~661. Based upon the shape of the

tine envelope 655, the tips and/or electrodes associated with the tines 651 may be positioned so as to interface with an elongate span of a lumen into which the guidewire tip 661 is placed. In aspects, the guidewire tip 661 may be formed into a guidewire with the addition of a jacket and/or a coil 663, etc.

[00334] Figs. 7a-b show aspects of a guidewire 701 and surgical device 705 each in accordance with the present disclosure, positioned within an organ 1 within a body. Fig. 7a shows a guidewire 701 in accordance with the present disclosure. The guidewire 701 includes a sensing tip 703 in accordance with the present disclosure. The guidewire 701 is shown positioned such that the sensing tip 703 is coupled with an anatomical site of interest 13 (i.e. one or more sites along the renal pelvic wall, etc.). In aspects, the guidewire 701 may be configured to monitor afferent nerve traffic associated with the receptors lining the renal pelvic wall 13. An addition surgical device 705 is shown having been delivered to the organ 1 via the guidewire 701.

[00335] In Fig. 7a the surgical device 705 is a fluid exchange catheter, configured with a plurality of lumens so as to deliver fluid 709 and return fluid 711 to an external unit (not explicitly shown). The external unit may include a heating element so as to provide a warm fluid to be circulated through the surgical device 705 to the intended surgical site (in this non-limiting example, the renal pelvic wall). In aspects, the fluid delivery may be used to increase the temperature of the wall of the renal pelvis to more than 40C, more than 50C, more than 60C or the like. Such an operation may be advantageous for blunting the activity of the afferent nerves within the wall of the renal pelvis. In aspects, alternative surgical tools, ablation techniques, etc. may be implemented as part of the surgical procedure (i.e. an RF or microwave ablation instead of a hot fluid lavage). In aspects, the fluid delivery catheter maybe configured to deliver a bolus of a neuroblocker, a neurostimulant, a neurodepressant, etc. In aspects, the fluid delivery catheter may be configured so as to provide a portion of a stress test for the organ 1 in accordance with the present disclosure.

[00336] In aspects, the surgical device 705 may include a balloon 707 to facilitate positioning, block off other regions of the body from a saline lavage, facilitate intimate contact with a lumen during a surgical procedure, combinations thereof, or the like.

the carotid body 15 that are suitable for neuromodulation to treat a particular condition. In aspects, the method may include selectively treating one or more sites 811 within or in the vicinity of the carotid body 15. In aspects, the method may include monitoring activity and/or local physiologic response to the treatment at one or more of the sites 811 to determine the extent of the procedure, to evaluate when the procedure has been completed, to decide whether or not to continue with the procedure, etc. The method may include ablating a portion of the carotid body 15, or a neurological structure coupled thereto, in accordance with the present disclosure. In aspects, the method may include using a guidewire and/or surgical device in accordance with the present disclosure to perform one or more of the above steps.

[00342] In aspects the method may include dragging one or more electrode arrays in accordance with the present disclosure along a lumen in the vicinity of the carotid body 15 in order to locate the body, locate neurological features of interest associated with the body, locate one or more baroreceptors, map activity thereof, map functional changes thereof due to application of a treatment or stress thereto, evaluate the function thereof, and/or treat one or more such structures.

[00343] Fig. 8b shows aspects of a surgical device 801 in accordance with the present disclosure. The surgical device 801 may be delivered to the carotid bifurication 19 within a subject through the common carotid artery 17 and positioned within the carotid bifurication 19, or along either of the external carotid artery 21 or the internal carotid artery 23 so as to access the carotid body 15 with one or more components thereof. The surgical device 801 may be configured so as to deploy one or more sensors and/or electrodes each in accordance with the present disclosure onto the wall of the artery 17, 21, 23 or through the wall of the artery 17, 21, 23 into the carotid body 15 or the tissues in the vicinity thereof. In aspects, the surgical device 801 may include one or more microneedle electrodes, fluid delivery needles, etc. each in accordance with the present disclosure so as to penetrate through the wall of the artery 17, 21, 23 and gain access to the carotid body 15. One or more elements within the surgical device 801 may be coupled with a connector and/or controller 802 at the proximal end thereof. The surgical device 801 may include a landing region ~~802~~ 810 configured so as to retain a position along a wall of an adjacent lumen 17, 21, 23 during deployment, monitoring, etc.

[00344] During use of a surgical device 801 in a method in accordance with the present disclosure, the deployed tips 804 may be dragged 806 along the walls of the lumen 17, 21, 23 so as to map, locate, monitor, stress, stimulate, and/or treat one or more target tissues within the vicinity thereof.

[00345] Fig. 8c illustrates aspects of a surgical device 801 interfaced with the carotid body 15. The surgical device 801 includes a plurality of needle-like microfingers 803 in accordance with the present disclosure, each microfinger 803 may be tipped with a sensor and/or electrode each in accordance with the present disclosure. The microfingers 803 may be advanced 809 into the tissues around the carotid bifurication so as to couple one or more of the sensors and/or electrodes with the carotid body 15 thus creating one or more monitoring sites 811a-e within or around the carotid body 15. The device 801 may include a jacket 807 to alter the stiffness of one or more segments of the device 801, to protect the microfingers 803 of the sensing tip, etc. In aspects, the device 801 may include one or more stabilizing members 805 or balloon, configured so as to stabilize and/or orient one or more regions of device 801 near to the intended surgical site. Once stabilized, the microfingers 803 may be advanced towards the carotid body 15. In aspects, the device 801 may include one or more radiopaque markers, or may be constructed with one or more radiopaque materials in order to assist a surgeon with visualization of the surgical site during the procedure. In aspects, the stabilizing members 805 may be configured to limit relative motion between the microfinger tips (i.e. the electrodes) and the carotid body 15 during one or more surgical procedures performed thereon.

[00346] In aspects, the surgical device 801 may be used to monitor sites 811a-e within and around the carotid body 15 to assist in selectively ablating only a region of the carotid body (e.g. an outer layer, a surface, etc.). In aspects, the surgical device 801 may be used to both sense and selectively ablate regions of the carotid body 15. In such procedures, the sensing may be performed with or without stimulation/stress to determine the ideal locations within the carotid body 15 to perform neuromodulation. Upon determining the ideal locations, an RF current, a microbolus of neurotoxin, etc. may be injected into key sites amongst the monitoring sites 811a-e. Such a procedure may be advantageous for neuromodulating the carotid body 15 while limiting damage to

WHAT IS CLAIMED IS:

1. A guidewire for monitoring electrophysiological activity in the vicinity of an anatomical site of interest within the vicinity of a lumen within a body, the guidewire comprising:

an elongate body dimensioned for insertion into the lumen; and

a sensing tip electrically and mechanically coupled to the elongate body, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with the activity.

2. The guidewire in accordance with claim 1, wherein the sensing tip comprises one or more electrodes, the electrodes dimensioned and configured to interface with the anatomical site of interest upon placement thereby.

3. The guidewire in accordance with claim 1 or 2, wherein the sensing tip includes a sensor configured to measure one or more electrophysiological signals related to one or more of water concentration, tone, evoked potential, remote stimulation of nervous activity, an electromyographic signal [EMG], a mechanomyographic signal [MMG], a local field potential, an electroacoustic event, vasodilation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive, tissue tone, nerve traffic, or combinations thereof.

4. The guidewire in accordance with any preceding claim, wherein the sensing tip is dimensioned and configured for placement into the parenchyma of an organ coupled with the lumen.

~~5. The guidewire in accordance with claim 4, wherein the sensing tip is dimensioned and configured for placement into a renal cortex of a kidney, an adrenal gland, an adrenal medulla, an adrenal cortex, and/or a renal pelvis of a kidney.~~

~~6. The guidewire in accordance with any preceding claim, wherein the sensing tip is configured such that the sensor and/or the electrode comprised therein is substantially isolated from a fluid within the lumen upon deployment of the sensing tip within the lumen.~~

~~7. The guidewire in accordance with any preceding claim, wherein the sensing tip is configured such that the sensor and/or electrode comprised therein maintains contact with a wall of the lumen during a procedure upon deployment of the sensing tip within the lumen.~~

~~8. The guidewire in accordance with claim 7, wherein the sensor and/or electrode substantially maintains contact with the wall of the lumen while the sensing tip is dragged along the interior thereof, after deployment of the sensing tip within the lumen.~~

~~9. The guidewire in accordance with any preceding claim, wherein the sensing tip is configured such that the sensor and/or electrode is embedded into a wall of the lumen upon deployment of the sensing tip within the lumen.~~

~~10. The guidewire in accordance with any preceding claim, wherein the guidewire is coupled to a second surgical device, the second surgical device configured to perform an ablation and/or stimulation procedure within the body.~~

~~11. The guidewire in accordance with claim 10, the second surgical device providing a reference electrode electrically coupled with one or more of the sensors and/or electrodes comprised within the guidewire.~~

~~12. The guidewire in accordance with any preceding claim comprising a microcircuit coupled to the sensing tip, configured to convey one or more sensed physiologic signals to a proximal end of the guidewire.~~

~~13. The guidewire in accordance with any preceding claim, wherein the sensing tip is electrically coupled with a microcircuit, the microcircuit configured to condition the signal.~~

~~14. The guidewire in accordance with claim 13, wherein the microcircuit is configured to perform a digital conversion of the signal.~~

~~15. The guidewire in accordance with any one of claims 12 – 14, wherein the microcircuit is configured to multiplex signals from a plurality of sensors and/or electrodes comprised within the guidewire.~~

~~16. The guidewire in accordance with any preceding claim, wherein the guidewire comprises one or more electrodes electrically and mechanically coupled with the elongate body, configured to deliver energy to the anatomical site of interest upon placement thereby.~~

~~17. The guidewire in accordance with any preceding claim, wherein the guidewire comprises one or more microneedles slidingly coupled with the elongate body, configured so as to be deployed beyond the elongate body into the anatomical site of interest upon placement thereby.~~

~~18. The guidewire in accordance with claim 17, wherein one or more of the microneedles includes a lumen through which a substance may be delivered to the anatomical site of interest upon deployment of the microneedle there into.~~

~~19. The guidewire in accordance with claim 18, wherein the substance is a neurotoxin, a cancer treating agent, a neuroblocking agent, a neurostimulating agent, a neurodepressant, a vasodilator, a vasoconstrictor, glucose, insulin, a combination thereof, or a formulation of the substance with a delivery vehicle.~~

~~20. The guidewire in accordance with claim 18 or 19, wherein one or more of the microneedles includes one or more electrodes for sensing, stimulating, and/or ablating the anatomical site of interest upon deployment of the microneedle there into.~~

~~21. Use of a guidewire in accordance with any one of claims 1 – 20, to monitor electrophysiological activity in the vicinity of a vessel, an artery, a vein, a renal artery, or a hepatic artery.~~

~~22. Use of a guidewire in accordance with any one of claims 1 – 20, to monitor electrophysiological activity in the parenchyma of an organ, a kidney, a renal cortex, a gland, an adrenal gland, a liver, a pancreas, a spleen, a prostate, or a renal pelvis, an arteriole, venule, or vesicle associated therewith.~~

~~23. Use of a guidewire in accordance with any one of claims 1 – 20, to perform and/or monitor a neuromodulation procedure.~~

~~24. Use of a guidewire in accordance with any one of claims 1 – 20, to evaluate a sympathetic and/or parasympathetic activity level associated with an organ, a process associated with the organ, or a region thereof within a body.~~

~~25. A system for neuromodulating an anatomical site in the vicinity of a lumen, comprising:~~

~~a subsystem configured to perform a surgical procedure on the anatomical site;~~

~~a guidewire in accordance with any one of claims 1 – 20, configured to monitor electrophysiological activity within the parenchyma of an organ coupled to the lumen and to generate one or more signals therefrom; and~~

~~a control unit configured to accept signals from the guidewire, and to adjust the surgical procedure dependent upon the signals, to display the signals, to evaluate the surgical procedure dependent upon the signals, to plan a surgical path dependent upon the signals, and/or to determine the extent of the procedure dependent upon the signals.~~

~~26. The system in accordance with claim 25, wherein the surgical procedure is selected from the group consisting of an ablation, an excision, a cut, a burn, a radio frequency ablation, radiosurgery, an ultrasonic ablation, an abrasion, a biopsy, and delivery of a substance.~~

~~27. The system in accordance with claim 25 or 26, comprising a stimulation and/or ablation electrode configured so as to convey a pulsatile and/or radio frequency signal to the anatomical site from the control unit, the guidewire configured to convey one or more feedback signals related to the pulsatile and/or radio frequency signals back to the control unit.~~

28. The system in accordance with claim 27, wherein the feedback signals are related to an electrode impedance, a bioimpedance, a local electrical field, or an electrophysiological response to the pulsatile and/or radio frequency signal.

29. The system in accordance with any one of claims 25-28, wherein the stimulation and/or ablation electrode is comprised within the guidewire.

30. The system in accordance with claim 29, wherein the stimulation and/or ablation electrode is comprised within the sensing tip of the guidewire.

31. The system in accordance with any one of claims 25-30, wherein the subsystem is situated coaxially with the guidewire in the lumen.

32. The system in accordance with any one of claims 25—31, comprising a sensor to measure one or more physiologic signals associated with a body comprising the lumen, and to convey the physiologic signals to the control unit for use in the procedure.

33. The system in accordance with claim 32, wherein the sensor is configured to measure one or more of water concentration, tone, blood oxygen saturation of local tissues, evoked potential, stimulation/sensing of nervous activity, electromyography, temperature, blood pressure, vasodilation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive, tissue tone, blood flow, a blood flow differential signal, blood perfusion, pupil dilation, electrolyte levels in a biofluid, a blood analyte level, nerve traffic, or a combination thereof.

34. A method for evaluating sympathetic tone of a subject, comprising:

recording electrophysiological signals from a lumen and/or from one or more sites within an organ of the subject; and

~~generating a metric relating to sympathetic tone from the recorded signals.~~

~~35. The method in accordance with claim 34, wherein the act of recording is at least partially facilitated by a guidewire in accordance with any one of claims 1 – 20.~~

~~36. The method in accordance with any one of claims 34 or 35, comprising applying a stress test to the subject during the recording.~~

~~37. The method in accordance with claim 36, wherein the stress test is selected from the group consisting of having the subject perform a valsalva maneuver, a tilt table test, elevating one or more legs, transient siting to standing exercises, execute a change in posture, move from a prone position to a sitting or standing position, a breath hold technique, or combinations thereof.~~

~~38. The method in accordance with claim 37, wherein the metric is generated from recordings taken while the subject is awake or asleep, assessment while awake versus under anesthesia, before, during and/or after electrostimulation at one or more sites on the subject, or combinations thereof.~~

~~39. The method in accordance with claim 36, wherein the stress test includes injecting into the subject a vasodilator, a vasoconstrictor, a neuroblocker, a neurostimulant, a diuretic, insulin, glucose, beta-adrenergic receptor antagonist, angiotensin-II-converting enzyme inhibitor, calcium channel blocker, an HMG-CoA reductase inhibitor, digoxin, an anticoagulant, a diuretic, a beta-blocker, an ACE inhibitor, a steroid, or combination thereof.~~

~~40. The method in accordance with claim 39, wherein the injection is into the lumen and/or into the organ.~~

41. The method in accordance with one of claims 39 – 40, wherein the step of injection is provided by a guidewire in accordance with any one of claims 1 – 20.

42. The method in accordance with any one of claims 36 – 41, wherein the stress test comprises having the subject perform a physical activity.

43. The method in accordance with any one of claims 36 – 41, wherein the stress test comprises altering the blood volume of the subject.

44. The method in accordance with claim 43, comprising injecting a quantity of saline into the subject.

45. The method in accordance with any one of claims 36 – 44 comprising evaluating how the activity responds to the stress test, comparing the response to a previous stress test performed on the subject, comparing the response to a population average response to the stress test, comparing aspects within a single stress test, comparing the activity before and after a procedure, comparing the activity between a resting state and an active state, comparing activity between an awakened state and a sleeping state, or combinations thereof.

46. The method in accordance with any one of claims 34 – 45 comprising neuromodulating one or more anatomical sites within the subject.

47. The method in accordance with any one of claims 34 – 46, comprising altering the heartbeat of the subject.

48. The method in accordance with any one of claims 34 – 47, comprising inserting a balloon catheter into a lumen coupled to the organ and temporarily blocking the lumen.

49. The method in accordance with any one of claims 34 – 48, comprising applying a polarizing potential to one or more sites in the organ and/or the lumen wall.

The method in accordance with any one of claims 34 – 49, comprising

monitoring another physiologic parameter remotely from the lumen to

generate a

~~corrective signal and using the corrective signal to remove movement artifacts from the electrophysiological signals.~~

~~51. The method in accordance with one of claims 34 – 50, comprising stimulating one or more anatomical sites in the subject during the recording.~~

~~52. The method in accordance with any one of claims 34 – 51, comprising diagnosing a medical condition based at least in part upon the metric.~~

~~53. A method for determining the properties of one or more neurological features in the vicinity of one or more monitoring sites, comprising:~~

~~monitoring one or more of water concentration, tone, blood oxygen saturation of local tissues, evoked potential, stimulation/sensing of nervous activity, electromyography, temperature, blood pressure, vasodilation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive, tissue tone, blood flow (e.g. through an artery, through a renal artery), a blood flow differential signal, blood perfusion, pupil dilation, electrolyte levels in a biofluid, a blood analyte level, nerve traffic, or combinations thereof, at one or more of the monitoring sites to generate one or more physiologic signals;~~

~~applying a stress test to the subject; and~~

~~evaluating the physiologic signals obtained from each monitoring site to determine an anatomical map therefrom.~~

~~54. The method in accordance with claim 53, comprising using the anatomical map to selectively ablate one or more of the sites.~~

55. The method in accordance with any one of claims 53 or 54, comprising determining if a monitoring site comprises substantially more sympathetic or parasympathetic neurological features.

56. The method in accordance with any one of claims 53 – 55, comprising applying energy in the vicinity of the lumen so as to induce a neurological block in the vicinity thereof.

57. The method in accordance with claim 56, comprising comparing the physiologic signals obtained before the neurological block to those obtained during the neurological block to determine the influence of the neurological block there upon.

58. The method in accordance with any one of claims 56 – 57, comprising determining if the neurological block is favorable in terms of treating an underlying disease state in the body.

59. The method in accordance with any one of claims 56 – 58, comprising applying energy in the vicinity of the lumen so as to induce a substantially permanent neurological block in the vicinity of selected monitoring sites.

Use of a method in accordance with any one of claims 53 – 59 for evaluation of the effectiveness of a neuromodulation procedure within a body.

CLAIMS

1. A guidewire, comprising:

an elongate body dimensioned for insertion into a lumen within a body; and

a sensing tip electrically and mechanically coupled to the elongate body, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with an electrophysiological activity in the vicinity of an anatomical site of interest within the vicinity of the lumen;

wherein the guidewire is configured to monitor the electrophysiological activity.

2. The guidewire in accordance with claim 1, wherein the sensing tip comprises one or more electrodes, the one or more electrodes dimensioned and configured to interface with the anatomical site of interest upon placement thereby.

3. The guidewire in accordance with claim 1, wherein the sensing tip includes a sensor configured to measure one or more electrophysiological signals related to one or more of water concentration, tone, evoked potential, remote stimulation of nervous activity, an electromyographic signal, a mechanomyographic signal, a local field potential, an electroacoustic event, vasodilation, vessel wall stiffness, muscle sympathetic nerve activity, central sympathetic drive, tissue tone, nerve traffic, or combinations thereof.

4. The guidewire in accordance with claim 1, wherein the sensing tip is dimensioned and configured for placement into a parenchyma of an organ coupled with the lumen.

5. The guidewire in accordance with claim 4, wherein the sensing tip is dimensioned and configured for placement into at least one of a renal cortex of a kidney, an adrenal gland, an adrenal medulla, an adrenal cortex, and a renal pelvis of a kidney.

6. The guidewire in accordance with claim 3, wherein the sensing tip is configured such that at least one of the sensor and the one or more electrodes comprised therein is substantially isolated from a fluid within the lumen upon deployment of the sensing tip within the lumen.

7. The guidewire in accordance with claim 3, wherein the sensing tip is configured such that at least one of the sensor and the one or more electrodes comprised therein maintains contact with a wall of the lumen during a procedure upon deployment of the sensing tip within the lumen.

8. The guidewire in accordance with claim 7, wherein at least one of the sensor and the one or more electrodes substantially maintains contact with the wall of the lumen while the sensing tip is dragged along the interior thereof, after deployment of the sensing tip within the lumen.

9. The guidewire in accordance with claim 3, wherein the sensing tip is configured such that at least one of the sensor and the one or more electrodes is embedded into a wall of the lumen upon deployment of the sensing tip within the lumen.

10. The guidewire in accordance with claim 3, wherein the guidewire is coupled to a second surgical device, the second surgical device configured to perform at least one of an ablation procedure and a stimulation procedure within the body.

11. The guidewire in accordance with claim 10, wherein the second surgical device provides a reference electrode electrically coupled with at least one of the sensors and electrodes comprised within the guidewire.

12. The guidewire in accordance with claim 1, further comprising a microcircuit coupled to the sensing tip, configured to convey one or more sensed physiologic signals to a proximal end of the guidewire.

13. The guidewire in accordance with claim 1, wherein the sensing tip is electrically coupled with a microcircuit, the microcircuit configured to condition the signal.

14. The guidewire in accordance with claim 13, wherein the microcircuit is configured to perform a digital conversion of the signal.

15. The guidewire in accordance with claim 12, wherein the microcircuit is configured to multiplex signals from at least one of the sensors and electrodes comprised within the guidewire.

16. The guidewire in accordance with claim 1, wherein the guidewire comprises one or more electrodes electrically and mechanically coupled with the elongate body, configured to deliver energy to the anatomical site of interest upon placement thereby.

17. The guidewire in accordance with claim 1, wherein the guidewire comprises one or more microneedles slidingly coupled with the elongate body, configured so as to be deployed beyond the elongate body into the anatomical site of interest upon placement thereby.

18. The guidewire in accordance with claim 17, wherein at least one of the one or more microneedles comprises a lumen through which a substance may be delivered to the anatomical site of interest upon deployment of the microneedle there into.

19. The guidewire in accordance with claim 18, wherein the substance is one of a neurotoxin, a cancer treating agent, a neuroblocking agent, a neurostimulating agent, a neurodepressant, a vasodilator, a vasoconstrictor, glucose, insulin, a combination thereof, and a formulation of the substance with a delivery vehicle.

20. The guidewire in accordance with claim 18, wherein at least one of the one or more microneedles comprises one or more electrodes for at least one of sensing, stimulating, and ablating the anatomical site of interest upon deployment of the microneedle there into.

21. The guidewire of claim 1, wherein the guidewire comprises a diameter one of less than 1mm, less than 0.15mm, less than 0.5mm, and less than 0.25mm.

22. A system for neuromodulating an anatomical site in a vicinity of a lumen, comprising:

a subsystem configured to perform a surgical procedure on the anatomical site;

a guidewire configured to monitor electrophysiological activity within a parenchyma of an organ coupled to the lumen and to generate one or more signals therefrom; and

a control unit configured to accept signals from the guidewire, and to at least one of: adjust the surgical procedure dependent upon the signals; display the signals; evaluate the surgical procedure dependent upon the signals; plan a surgical path dependent upon the signals; and determine the extent of the procedure dependent upon the signals;

wherein the guidewire comprises:

an elongate body dimensioned for insertion into a lumen within a body; and

a sensing tip electrically and mechanically coupled to the elongate body, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with an electrophysiological activity in the vicinity of an anatomical site of interest within the vicinity of the lumen.

23. The system in accordance with claim 22, wherein the surgical procedure is selected from the group consisting of an ablation, an excision, a cut, a burn, a radio frequency ablation, radiosurgery, an ultrasonic ablation, an abrasion, a biopsy, and delivery of a substance.

24. The system in accordance with claim 22, further comprising at least one of a stimulation electrode and an ablation electrode configured so as to convey at least one of a pulsatile frequency signal and a radio frequency signal to the anatomical site from the control unit, the guidewire configured to convey one or more feedback signals related to at least one of the pulsatile frequency signal and radio frequency signal back to the control unit.

25. The system in accordance with claim 24, wherein the one or more feedback signals are related to an electrode impedance, a bioimpedance, a local electrical field, or an electrophysiological response to at least one of the pulsatile frequency signal and radio frequency signal.

26. The system in accordance with any one of claim 24, wherein at least one of the stimulation electrode and ablation electrode is comprised within the guidewire.

27. The system in accordance with claim 26, wherein at least one of the stimulation electrode and ablation electrode is comprised within the sensing tip of the guidewire.

28. The system in accordance with claim 22, wherein the subsystem is situated coaxially with the guidewire in the lumen.

29. The system in accordance with claim 22, further comprising a sensor to measure one or more physiologic signals associated with a body comprising the lumen, and to convey the physiologic signals to the control unit for use in the procedure.

30. The system in accordance with claim 29, wherein the sensor is configured to measure one or more of water concentration, tone, blood oxygen saturation of local tissues, evoked potential, stimulation of nervous activity, sensing of nervous activity, electromyography, temperature, blood pressure, vasodilation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive, tissue tone, blood flow, a blood flow differential signal, blood perfusion, pupil dilation, electrolyte levels in a biofluid, a blood analyte level, nerve traffic, or a combination thereof.

31. The system of claim 22, wherein the subsystem is provided over the guidewire to perform the surgical procedure on the anatomical site.