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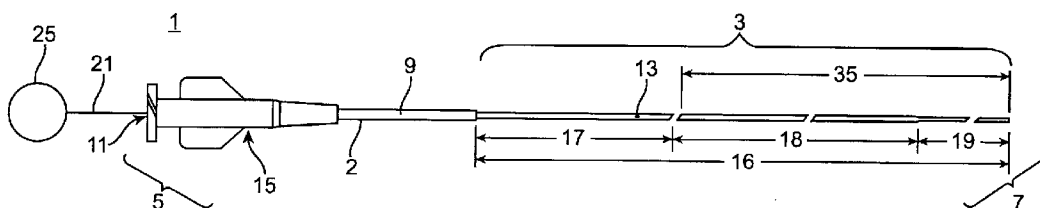
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(54) Title: SINGLE LUMEN SUPPORT CATHETER FOR RAPID EXCHANGE AND OVER THE WIRE USE



(57) Abstract: Embodiments of the present invention include systems and methods for providing and using a low profile, single lumen catheter that can be removed from a short guide wire when the guide wire extends through the full length of the catheter. The catheter provides a distal guide wire port configured for rapid exchange procedures. The distal guide wire port may be blocked using a slidable member to enable fluid infusion and guide wire exchange. The catheter may include a longitudinal slit from a distal guide wire port to a proximal guide wire port that permits removal of a proximal portion of the guide wire from the catheter by way of the slit so as to enable removal of the catheter by rapid exchange mode.



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SINGLE LUMEN SUPPORT CATHETER FOR RAPID EXCHANGE AND OVER THE WIRE USE

CROSS-REFERENCES TO RELATED APPLICATIONS

- 5 **[0001]** This application claims the benefit of priority from U.S. provisional application No. 60/819,487, filed July 7, 2006, the entirety of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to the field of catheters for medical, diagnostic, and/or therapeutic uses.

- 10 **[0003]** Catheters are used for many clinical purposes. As some examples, infusion catheters may be used to deliver diagnostic or therapeutic fluids to sites in the vasculature. Moreover, in angioplasty procedures, a balloon catheter may be inserted over a guide wire to an occluded site in order to increase blood flow. Similarly, a catheter containing optical fibers may be used to view an intravascular site or to deliver laser energy for laser
15 atherectomy, laser ablation, or other purposes.

- [0004]** Regardless of the specific purpose, the intravascular catheter is often used in conjunction with a thinner steerable guide wire. Typically the clinician first inserts the guide wire into a blood vessel in a patient's extremity and steers the guide wire through the vasculature to a target site. Then, the clinician inserts the larger catheter over the guide wire
20 and advances the catheter over the guide wire to the target site. This guide wire and catheter combination allows the guide wire to be inserted into place before the catheter, thus making it easier to position the catheter. Sometimes the guide wire is removed and the clinician proceeds to use the catheter for the desired purpose, whether for infusion, diagnosis, or treatment. Alternatively, the guide wire may be left in place, the catheter treatment may be
25 performed, and the catheter may then be withdrawn and replaced with a different catheter, for example, a laser catheter may be replaced with a balloon catheter to treat an occlusion.

- [0005]** Current infusion, support, and guide wire exchange catheters are often "over-the-wire" ("OTW") designs. An OTW catheter design is characterized by having a lumen or passageway throughout the entire working length which is adapted for the free movement of
30 a guide wire, which may exit at the catheter's proximal end lying outside of the patient's

body. The OTW catheter design allows for infusion of diagnostic media, drugs, and guide wire exchange from the proximal end of the catheter. However, in order to exchange these types of OTW catheters, longer guide wires or guide wire extensions, typically 300 cm in length, must be used. The exchange of devices over guide wires of this length is both time consuming and cumbersome.

[0006] A catheter design that addresses the shortcomings of the OTW catheter is a "monorail" or rapid exchange ("RX") catheter that uses shorter guide wires. In such RX designs, the catheter is characterized by having a guide wire passageway that extends within only a comparatively short distal segment of the catheter. The RX catheter's proximal exit port for the guide wire typically lies approximately 20 to 30 cm proximal to the catheter's distal end. These catheters can use shorter guide wires, typically 180 cm long, to remove or exchange catheters. In comparison to OTW designs, RX catheters are more quickly and easily exchanged. Illustrative designs for RX catheter systems can be found, for example, in U.S. Patent 6,592,549 to Gerdt et al. and U.S. Patent 7,037,293 to Carrillo et al., both of which are incorporated herein by reference. RX catheters, however, may require multiple catheter lumens and may not allow fluid infusion or convenient guide wire exchange.

[0007] In an exemplary procedure, a clinician may insert a short, 180 cm guide wire into the patient's distal extremity and spend considerable time navigating the guide wire to an occlusion of an artery. In order to cross the occlusion, the clinician decides that a different shape is needed on the tip of the wire. The conventional options to accomplish this task include: (1) pulling the guide wire out of the patient, thus losing the guide wire position, and reshaping and reinserting the guide wire; (2) using an exchange system (e.g., a trapper catheter or a magnet system) to affix the guide wire in the guide catheter, loading and advancing a support catheter to the distal end of the guide wire, pulling the guide wire out and reshaping the tip, then placing the guide wire back into the support catheter and advancing guide wire back to the original position; or (3) if the guide wire is extendible, the clinician could lengthen the short guide wire by docking an extension guide wire to its proximal end, then inserting a support catheter over the guide wire and subsequently withdrawing, reshaping, and reinserting the guide wire through the support catheter. Moreover, in order to remove the inserted support catheter from the guide wire disposed within the support catheter, the clinician must use a long (e.g., 300cm) guide wire.

[0008] In view of the foregoing, improved systems and methods are needed for providing and using a single lumen catheter that enables advantages of both RX and OTW designs.

BRIEF SUMMARY OF THE INVENTION

[0009] Embodiments of the present invention include system and methods for providing
5 and using a low profile, single lumen catheter which would retain the guide wire position obtained in the above example, enable rapid exchange of the catheter using a short guide wire, allow the clinician to infuse liquids, and remove and introduce guide wires or other devices without increased procedural time or use of additional ancillary products. Systems and methods are also provided such that the catheter can be removed from a short guide wire
10 when the guide wire initially extends through the full length of the catheter.

[0010] In some embodiments, a low profile, single lumen catheter is provided that includes a distal guide wire port configured for rapid exchange procedures. The distal guide wire port may be blocked using a slidable member to enable fluid infusion and guide wire exchange, particularly when the slidable member is hollow. The catheter may include a longitudinal slit
15 from the distal guide wire port to a proximal guide wire port that permits separation of the guide wire from the catheter as the catheter is removed from the patient. For example, as the proximal portion of the catheter is removed from the patient, a proximal portion of the guide wire may be separated from the catheter by pulling the guide wire from the catheter by way of the slit. This in turn enables removal of the catheter by rapid exchange mode over a short
20 guide wire.

[0011] The catheter of the present invention may be maneuvered and positioned in a vascular or other area and used in conjunction with a guide wire or other device to provide advantageous maneuverability characteristics. Additionally, other medical, diagnostic, or treatment catheters or other devices may be inserted into the support catheter for use within a
25 patient, including without limitation, infusing liquids into a patient.

[0012] Embodiments of the invention further provide methods for performing a medical, diagnostic, or therapeutic procedure with a catheter system that enables both OTW and RX modes.

[0013] Other aspects of the invention will be apparent to those skilled in the art after
30 reviewing the drawings and the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will now be described, by way of examples only, with reference to the accompanying drawings, in which:

[0015] FIGS. 1A and 1B are full and partial views of one embodiment of the invention showing the use of a solid slidable member.

[0016] FIGS. 2A and 2B are full and partial views of one embodiment of the invention showing the use of a hollow slidable member with a luer on its proximal end.

[0017] FIGS. 3A and 3B are full and partial views of one embodiment of the invention showing the use of a hollow slidable member with a luer on its proximal end, with the slidable member advanced to cover the distal guide wire port.

[0018] FIGS. 4A and 4B are full and partial views of one embodiment of the invention showing a longitudinal slit in the catheter from the distal guide wire port to the proximal guide wire port.

[0019] FIGS. 5A-5D illustrate an exemplary procedure in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Embodiments of the present invention provide a catheter that allows RX use, OTW use, guide wire exchange, infusion through the catheter, and other medical, diagnostic or therapeutic uses. The catheter of the invention has an inner lumen extending through its entire length. A distal guide wire port is provided in the catheter configured for rapid exchange procedures. The distal guide wire port may be blocked using a slidable member received within the catheter to enable fluid infusion and guide wire exchange. The catheter may include a longitudinal slit from the distal guide wire port to a proximal guide wire port that permits removal of a proximal portion of the guide wire from the catheter by way of the slit. When the proximal portion of the guide wire has been removed, only a distal portion of the guide wire remains within the catheter to enable removal of the catheter by rapid exchange mode.

[0021] Referring to FIGS. 1A and 1B, one embodiment of the invention provides a support catheter 1 having a proximal end 5 and a distal end 7. Support catheter 1 includes a catheter body 3 having a lumen 9 disposed longitudinally within the body 3. The proximal end 5 of

the catheter 1 includes a proximal guide wire port 11. A distal section of the catheter body 3 includes a distal guide wire port 13 (shown in FIG. 1B) that opens laterally from the lumen 9. The distal guide wire port 13 permits a guide wire (not shown) to exit the lumen 9. For example, when catheter 1 is used in an RX mode, a guide wire may pass through the distal tip 31 of the catheter body 3, through the lumen 9 and out of the catheter body 3 through the distal guide wire port 13. The distal guide wire port 13 is generally located between about 20 cm and 35 cm from the distal tip 31, although it may be disposed at other suitable locations.

[0022] The proximal end 5 of the catheter 1 may include a luer connector 15 or other member known to those of ordinary skill in the art to allow connection or maneuvering of the catheter. The catheter body 3 extends from the distal portion of the luer connector 15 to the distal end 7 and defines the lumen 9 in conjunction with the luer connector 15 such that the lumen 9 runs the full length of the catheter 1.

[0023] In a preferred embodiment, the luer connector 15 and the catheter body 3 are made from high density polyethylene ("HDPE") and the luer connector 15 is about 2.5 cm long and connected to a strain relief 2 (about 5 cm long) that connects to catheter body 3. The total length of the catheter body 3 is preferably approximately 135 cm, with a proximal portion having an outside diameter from about .028" to .068" and in some cases around 0.045", and an inside diameter from about .014" to .042" and in some cases around .024", and with a distal portion having an outside diameter from about .022" to .060" and in some cases around .029" and an inside diameter from about .012" to .042" and in some cases about .021".

[0024] In another preferred embodiment, a proximal portion of catheter 1 (e.g., from strain relief 2 to distal guidewire port 13) may be constructed via a braided metal wire construction such that it exhibits enough stiffness to introduce the catheter over a guide wire in an RX manner. For example, stainless steel wire may be braided together with plastic wire to form the proximal portion of catheter 1. In yet another preferred embodiment, the proximal portion of the catheter 1 may be a hypotube that provides stiffness and pushability to the catheter. The hypotube portion may include guidewire port 13 and may be connected to a small-diameter distal portion (e.g., the distal-most 25 cm of the catheter) formed of a plastic material to provide flexibility and low-trauma maneuverability in the patient's body. Both the braided metal wire construction and the metal hypotube construction may provide sufficient stiffness and pushability to the catheter 1 such that the use of a separate pushing mandrel

(e.g., element 21 described below) may not be needed to introduce the catheter into a patient's body over a guide wire.

[0025] In one embodiment, the proximal portion of the catheter preferably has a stiffness such that a 0.1-0.25 kg force produces a deflection of about 0.10" over a 3cm length of the catheter, whereby the force is applied and the deflection is measured at the center point of the length of catheter tested. Similarly, in another embodiment where the proximal portion of the catheter is formed of a NiTi hypotube, the stiffness is preferably such that a force of 0.005-0.18 kg produces a deflection of about 0.10" over a 2.5cm length of the hypotube.

[0026] As shown in FIGS. 1A and 1B, the catheter body 3 includes a tapered portion 16 which is intermediate the strain relief 2 and the most distal end 7 of the catheter. The tapering imparts a less traumatic profile to the distal end of the support catheter 1 when used in the patient. In some embodiments, the support catheter 1 exhibits a stiffness profile that progressively decreases from the proximal end 5 to the distal end 7. More particularly, tapered portion 16 of the catheter body may exhibit a stiffness profile that incrementally decreases from portion 17, to portion 18, to portion 19.

[0027] Portions 17, 18, and 19 may have sequentially smaller outer diameters that produce this stiffness profile. The decrease in diameter may result from continuous tapering of the catheter body from a proximal segment to a more distal segment; from one or more decreases in diameter of consecutive sections of the body; or any combination thereof. For example, in a preferred embodiment, without limitation, the catheter body 3 is comprised of a proximal segment 17 of about .045" OD, tapering about 25 cm from the distal tip to a more distal segment 18 of about .037" OD and about 18 cm long, which tapers to a third more distal segment 19 of about .029" OD and about 7 cm long.

[0028] Support catheter 1 may also include a slidable member 21 configured to be disposed within lumen 9. The slidable member 21 may be solid (e.g., 21' of FIG. 1B) or may include a lumen 22 (e.g., 21" of FIG. 2B). In an exemplary embodiment, the slidable member 21 is about 120 cm, with an outside diameter from .010" to .040" and in some cases around .022", and may be formed of stainless steel or nitinol. The slidable member 21 is configured such that it may be inserted through the proximal guide wire port 11 into the lumen 9 and advanced to a more distal segment of the catheter body 3.

[0029] The slidable member 21 may provide a pushability to the catheter, for example, when it is used in the RX mode. As shown in FIG. 1A, the proximal end of the slidable

member 21 may be configured for use with a handle 25. In one embodiment where the slidable member 21 is solid (e.g., FIG. 1B), the solid slidable member 21' can be removed through the proximal guide wire port 11 of the catheter to allow OTW use and guide wire exchange. In another embodiment where the slidable member 21 is hollow (e.g., FIG. 2B), the hollow slidable member 21" may be advanced such that member 21" covers and blocks the distal guide wire port 13 (as shown in FIG. 3B) to allow OTW use and/or infusion use of the catheter. For example, the proximal end of the hollow slidable member 21" may be connected with a luer 27 or other connector known to those of ordinary skill in the art which may be used to push the slidable member 21" forward or to pull the member back and out of the catheter 1. After any OTW use or infusion use is completed, the hollow slidable member 21" may be pulled back to expose the distal guide wire port 13 and re-enable RX mode functionality. In one embodiment, hollow slidable member 21" has about .022" ID and about .027" OD. In some embodiments, the proximal catheter shaft is about .029" ID and about .047" OD.

[0030] In another embodiment illustrated by FIGS. 4A and 4B, the catheter 1 includes a longitudinal slit 29 that extends into the lumen 9 from the exterior of the catheter. In one preferred embodiment, the slit 29 extends from the proximal guide wire port 11 to the distal guide wire port 13. As such, a guide wire (not shown) is disposed within the lumen 9 and may be removed from the lumen using slit 29 up to the location of distal guide wire port 13. When this has been done, the guide wire will be disposed only within a distal end of the catheter 1 (i.e., the portion between distal tip 31 and port 13) and the catheter can be removed from the guide wire in an RX manner. It should be noted that this removal step can only occur after slidable member 21 has been removed from the catheter 1. Therefore, slit 29 enables RX removal of the catheter 1 from short guide wires when the guide wire was initially disposed within the full length lumen of the catheter.

[0031] Optionally the distal tip 31 of the most distal segment of the catheter is beveled or tapered to give the catheter tip a less traumatic profile, thus enabling the tip to pass through vascular channels more easily. A marker band 33 comprised of a radiopaque material such as platinum-iridium or other suitable material may be disposed near the distal tip 31 of the catheter to aid in fluoroscopic or other visualization of the placement of distal tip 31. To improve the slidability and maneuverability of the support catheter 1, a portion 35 of the distal segment may be coated to reduce friction. For example, a lubricous hydrophilic coating or silicone may be applied to portion 35.

[0032] FIGS. 5A-5D show an exemplary procedure that illustrates, in operation, the improved systems and methods of the present invention. Embodiments of the invention provide a catheter system that enables the replacement of the catheter or the guide wire at a target site during medical, diagnostic, or therapeutic procedures. The catheter system may be advantageously used to position another catheter or other medical, diagnostic, or therapeutic device for use by a clinician. As illustrated by FIGS. 5A-5D, the catheter system may be used in conjunction with an angioplasty procedure. Such procedures are used to change or widen blood vessels, usually blood vessels narrowed or constricted by the build-up of atherosclerotic plaque.

[0033] As shown in FIG. 5A, a short (e.g., 180 cm) guide wire 50 is inserted into the vasculature 60 of a patient, often through an extremity, and navigated approximate a target site containing an occlusion 62. In the illustrative procedure, guide wire 50 may be positioned just proximal of the occlusion 62, for example, because the guide wire 50 is not adapted for crossing the occlusion 62. The clinician may wish to reshape or replace guide wire 50 so as to successfully cross the occlusion 62. As illustrated in FIG. 5B, a support catheter 1 as described above may be inserted into the patient's vasculature 60 over the short guide wire 50 using an RX technique such that distal tip 31 is approximate the distal tip of the guide wire 50. Fluoroscopic or radioscopy imaging may be used to verify alignment or positioning of the guide wire 50 and support catheter 1. As seen in FIG. 5B, guide wire 50 is only within lumen 9 at a distal portion of the catheter 1 and passes out of the lumen 9 at distal guide wire port 13. A hollow slidable member 21 may also be disposed within lumen 9 short of the guide wire port 13.

[0034] The guide wire 50 may then be removed and, as seen in FIG. 5C, and slidable member 21 may be pushed forward to cover the distal guide wire port 13. As previously described, slidable member 21 may be solid or hollow and may give a pushability to the catheter. For example, slidable member 21 can be used to push distal tip 31 against occlusion 62 in an effort to break or cross the occlusion. As shown in FIG. 5C, slidable member 21 is hollow and includes interior lumen 22. In this state, the catheter system may be used to inject fluids to the target site. For example, medication may be delivered to the occlusion 62 to soften or weaken the occlusion. Moreover, as shown in FIG. 5D, another short guide wire 50', for example one especially adapted for crossing the occlusion 62, may be inserted through lumen 22 to the target site in an OTW manner. Guide wire 50' may successfully

penetrate and cross occlusion 62 such that its distal tip is disposed on a distal side of the occlusion 62.

[0035] At this juncture in the exemplary procedure, the clinician may wish to remove the support catheter 1 such that it may be replaced with another catheter (e.g., a balloon catheter, an atherectomy catheter, or an imaging catheter) for additional medical, diagnostic, or treatment procedures. In order to enable removal of the catheter 1 over short guide wire 50', the hollow slidable member 21 is first withdrawn. The proximal portion of guide wire 50' may then be removed from the lumen 9 through slit 29 as the catheter 1 exits outside of the patient, in essence peeling the catheter 1 away from guide wire 50' as the catheter exits the patient. As such, catheter 1 can be removed guide wire 50' in an RX mode, which enables catheter 1 to be removed from the vasculature 60 without extending the proximal end of guide wire 50' or using other additional apparatus or procedures.

[0036] The support catheter according to the present invention is suitable for other applications in intravascular and other procedures. For some examples only, and without limitation, the support catheter may be used as a conduit for injecting therapeutic or diagnostic fluids. Moreover, the support catheter may be used as a conduit for exchanging guide wires or for maintaining position at a treatment site while a guide wire is withdrawn. Thus, if a clinician wishes to reshape a guide wire currently in place, the clinician can remove the guide wire through the support catheter while maintaining position with the support catheter. Once the guide wire is reshaped, it can be reinserted into the proximal port of the support catheter and advanced to the treatment site, as indicated above. Finally, the support catheter may be used to cross obstructions.

[0037] As some additional examples, a laser guide wire may be inserted into the proximal guide wire port and advanced to the target site. Laser energy is then applied to penetrate the obstruction, and the support catheter and the laser guide wire may be advanced in stepwise fashion. Once the occlusion is passed, the support catheter and/or the laser guide wire can be exchanged for standard angioplasty equipment to complete treatment of the obstruction. Illustrative designs for such systems can be found, for example, in U.S. Patents 5,514,128 and 5,643,251 to Hillsman et al., both of which are incorporated herein by reference.

[0038] Numerous variations on the above-described techniques and other uses will be readily apparent to those skilled in the art.

[0039] While the present invention has been particularly shown and described with reference to the foregoing preferred and alternative embodiments, it should be understood by those skilled in the art that various alternatives to the embodiments of the invention described herein may be employed in practicing the invention without departing from the spirit and scope of the invention as defined in the following claims. It is intended that the following claims define the scope of the invention and that the method and apparatus within the scope of these claims and their equivalents be covered thereby. This description of the invention should be understood to include all novel and non-obvious combinations of elements described herein, and claims may be presented in this or a later application to any novel and non-obvious combination of these elements. The foregoing embodiments are illustrative, and no single feature or element is essential to all possible combinations that may be claimed in this or a later application. Where the claims recite "a" or "a first" element of the equivalent thereof, such claims should be understood to include incorporation of one or more such elements, neither requiring nor excluding two or more such elements.

WHAT IS CLAIMED IS:

1. A catheter system for medical, diagnostic, or therapeutic use, comprising:
 - a catheter body having a proximal end, a distal end, and a single continuous lumen disposed therein extending from the proximal end to the distal end, wherein the proximal end of the catheter body includes a proximal guide wire port in communication with the lumen;
 - a distal guide wire port disposed laterally on the catheter body distal to the proximal guide wire port, wherein the distal guide wire port enables communication between an exterior and the lumen; and
 - a hollow slidable member configured to be received within the lumen through the proximal guide wire port and for translation within the catheter body to block or unblock the distal guide wire port.
2. The catheter system of claim 1, wherein the catheter system is configured to enable fluid injection and guide wire exchange through an interior of the hollow slidable member when the distal guide wire port is blocked, and wherein the catheter system is configured for removal in a rapid exchange mode when the distal guide wire port is unblocked.
3. The catheter system of claim 1, wherein the catheter body further comprises a longitudinal slit from the distal guide wire port to the proximal guide wire port that extends from the exterior into the lumen.
4. The catheter system of claim 3, wherein the slit enables a guide wire received within a full length of the lumen to be separated from the catheter along the slit.
5. The catheter system of claim 1, wherein at least a portion of the catheter body comprises at least one proximal portion having a first stiffness and at least one distal portion having a second stiffness less than said first stiffness.
6. The catheter system of claim 1, further comprising a luer disposed at the proximal end of the catheter body, the luer configured to include the proximal guide wire port.

7. The catheter system of claim 1, wherein the distal end of the catheter body includes a radiopaque marker band.

8. The catheter system of claim 1, wherein the catheter body comprises at least three segments of outer diameters that progressively decrease distally between segments.

9. The catheter system of claim 1, wherein at least a portion of the catheter body is formed from braided wire.

10. The catheter system of claim 1, wherein a distal portion of the catheter body is coated with an anti-friction material.

11. A catheter system for medical, diagnostic, or therapeutic use, comprising:

a catheter body having a proximal end, a distal end, and a single continuous lumen disposed therein extending from the proximal end to the distal end, wherein the proximal end of the catheter body includes a proximal guide wire port in communication with the lumen;

a distal guide wire port disposed laterally on the catheter body distal to the proximal guide wire port, wherein the distal guide wire port enables communication between an exterior and the lumen;

a hollow slidable member configured to be received within the lumen through the proximal guide wire port and for translation within the catheter body to block or unblock the distal guide wire port; and

a longitudinal slit in the catheter body from the distal guide wire port to the proximal guide wire port that extends from the exterior into the lumen.

12. A catheter system for medical, diagnostic, or therapeutic use, comprising:

a catheter body having a proximal end, a distal end, and a single continuous lumen disposed therein extending from the proximal end to the distal end, wherein the proximal end of the catheter body includes a proximal guide wire port in communication with the lumen;

a distal guide wire port disposed laterally on the catheter body distal to the proximal guide wire port, wherein the distal guide wire port enables communication between an exterior and the lumen;

a hollow slidable member configured to be received within the lumen through the proximal guide wire port and for translation within the catheter body to block or unblock the distal guide wire port;

a longitudinal slit in the catheter body from the distal guide wire port to the proximal guide wire port that extends from the exterior into the lumen, wherein at least a portion of the catheter body comprises at least one proximal portion having a first stiffness and at least one distal portion having a second stiffness less than said first stiffness.

13. A method for performing a medical, diagnostic, or therapeutic procedure with a catheter system that enables both OTW and RX modes, the method comprising:

inserting a first, short guide wire to a desired location within vasculature of the patient;

introducing a catheter having only a single lumen over the first guide wire in a rapid exchange mode to the desired location, such that only a distal portion of the catheter is over the first guide wire and a proximal portion of the first guide wire runs outside of the catheter through a distal guide wire port; and

positioning a hollow slidable member coaxially disposed within the lumen of the catheter to block the distal guide wire port.

14. The method of claim 13, further comprising injecting a fluid to the desired location through the hollow slidable member when the distal guide wire port is blocked.

15. The method of claim 12, further comprising pushing a distal tip of the catheter using the hollow slidable member.

16. The method of claim 12, further comprising inserting a second, short guide wire to the desired location through an interior of the hollow slidable member.

17. The method of claim 16, further comprising:
removing the hollow slidable member from within the catheter;

removing the proximal portion of the second guide wire from the lumen of the catheter through a longitudinal slit in the catheter while a distal portion of the second guide wire remains within the lumen of the catheter; and

removing the catheter from the second guide wire and the vasculature of the patient in an RX mode.

18. The method of claim 17, further comprising introducing a different catheter into the vasculature over the second guide wire.

19. The method of claim 13, wherein inserting a first, short guide wire comprises inserting a guide wire approximately 180 cm in length.

20. A catheter system for medical, diagnostic, or therapeutic use, comprising:

a catheter body having a proximal end, a distal end, and a single continuous lumen disposed therein extending from the proximal end to the distal end, wherein the proximal end of the catheter body includes a proximal guide wire port in communication with the lumen; and

a distal guide wire port disposed laterally on the catheter body distal to the proximal guide wire port, wherein the distal guide wire port enables communication between an exterior and the lumen, wherein the catheter body has a sufficient stiffness to enable introduction of the catheter system into a patient's body over a guide wire without the use of a separate pushing member.

21. The catheter system of claim 20 wherein at least a portion of the catheter body is formed of braided metal wire.

22. The catheter system of claim 21 wherein the metal wire is further braided with plastic wire.

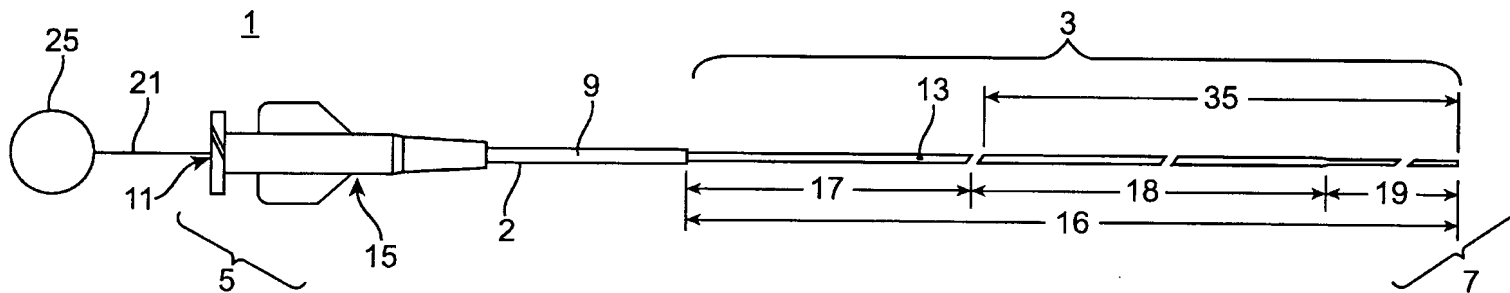


FIG. 1A

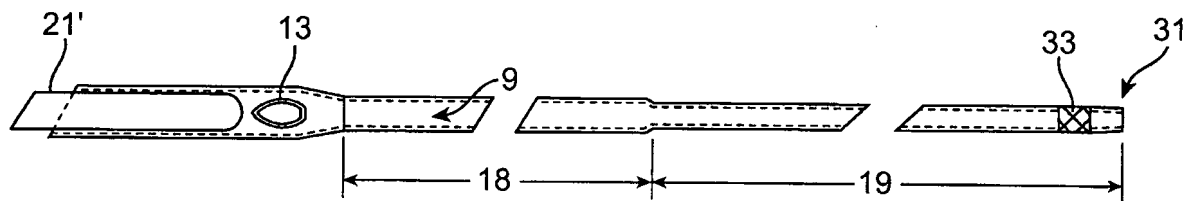


FIG. 1B

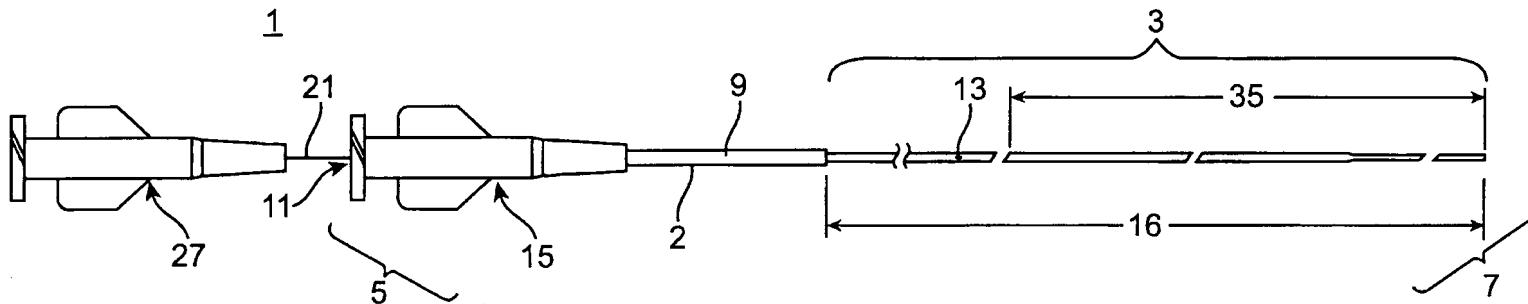


FIG. 2A

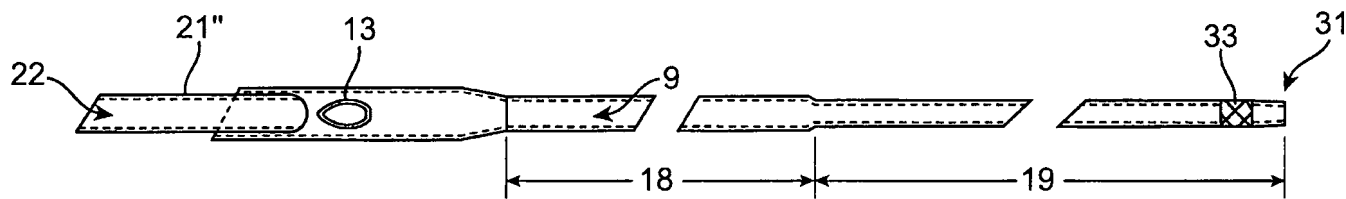


FIG. 2B

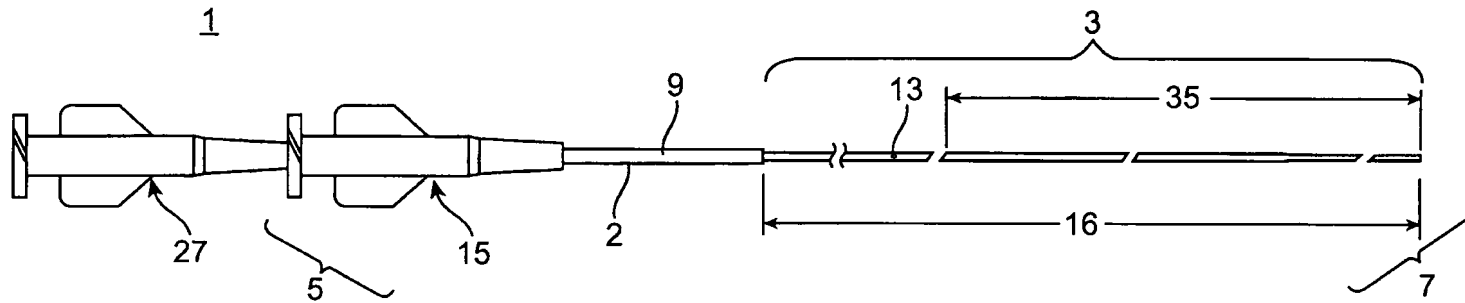


FIG. 3A

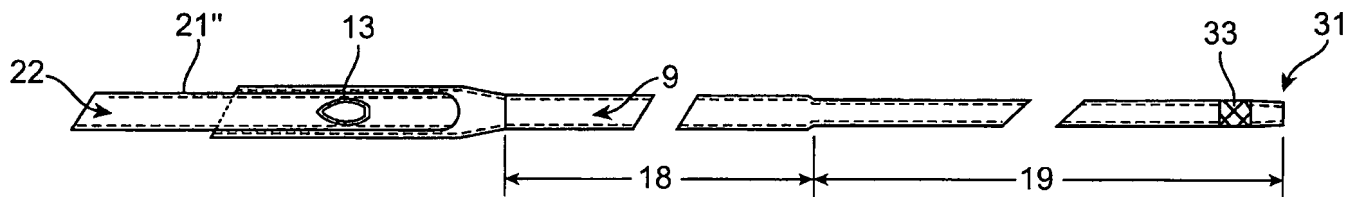


FIG. 3B

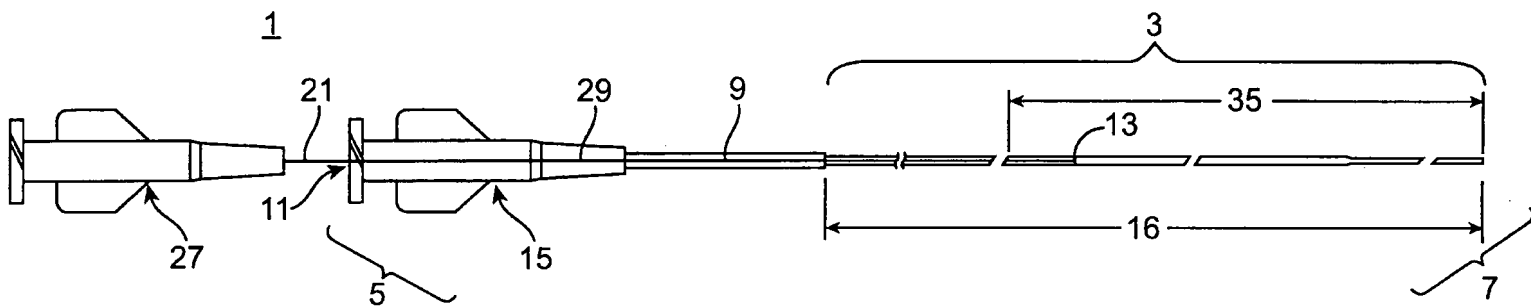


FIG. 4A

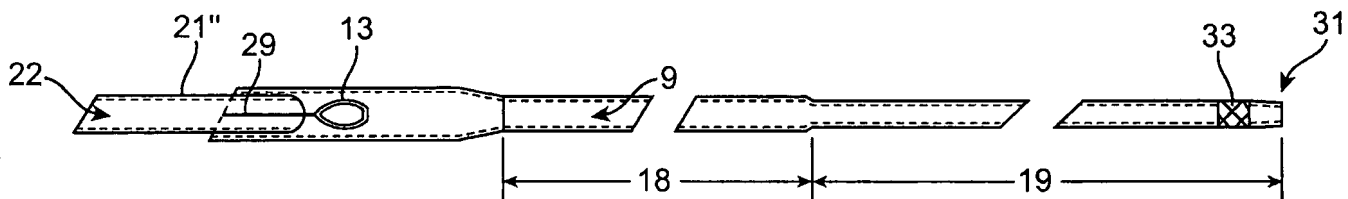


FIG. 4B

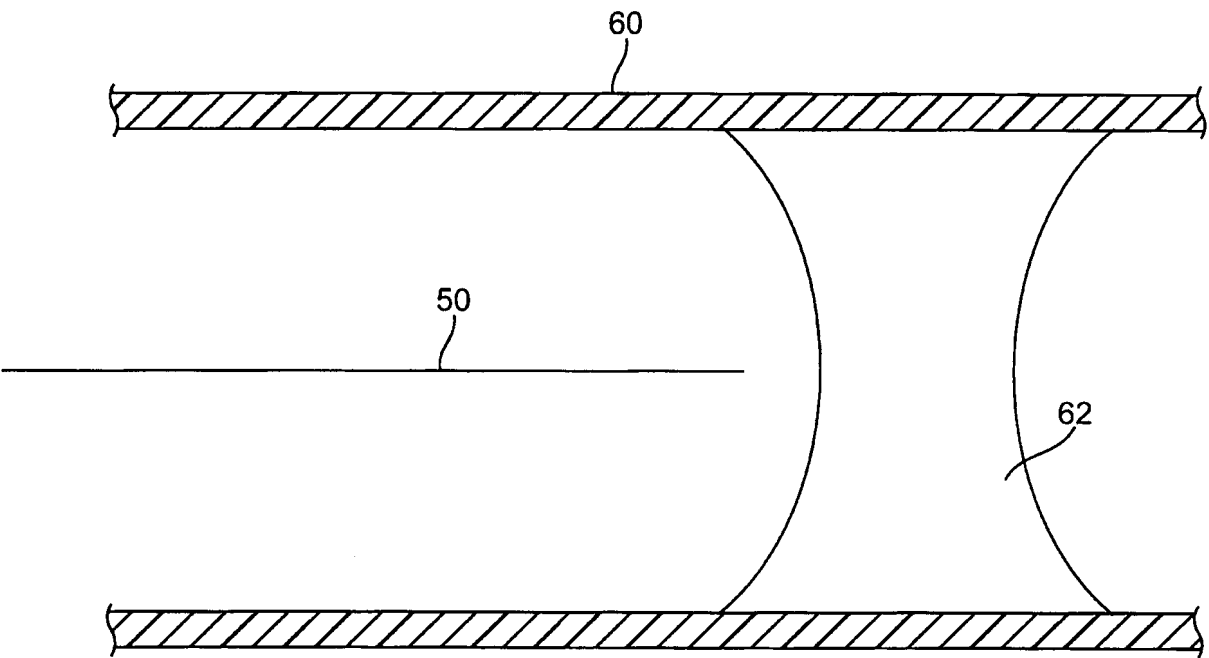


FIG. 5A

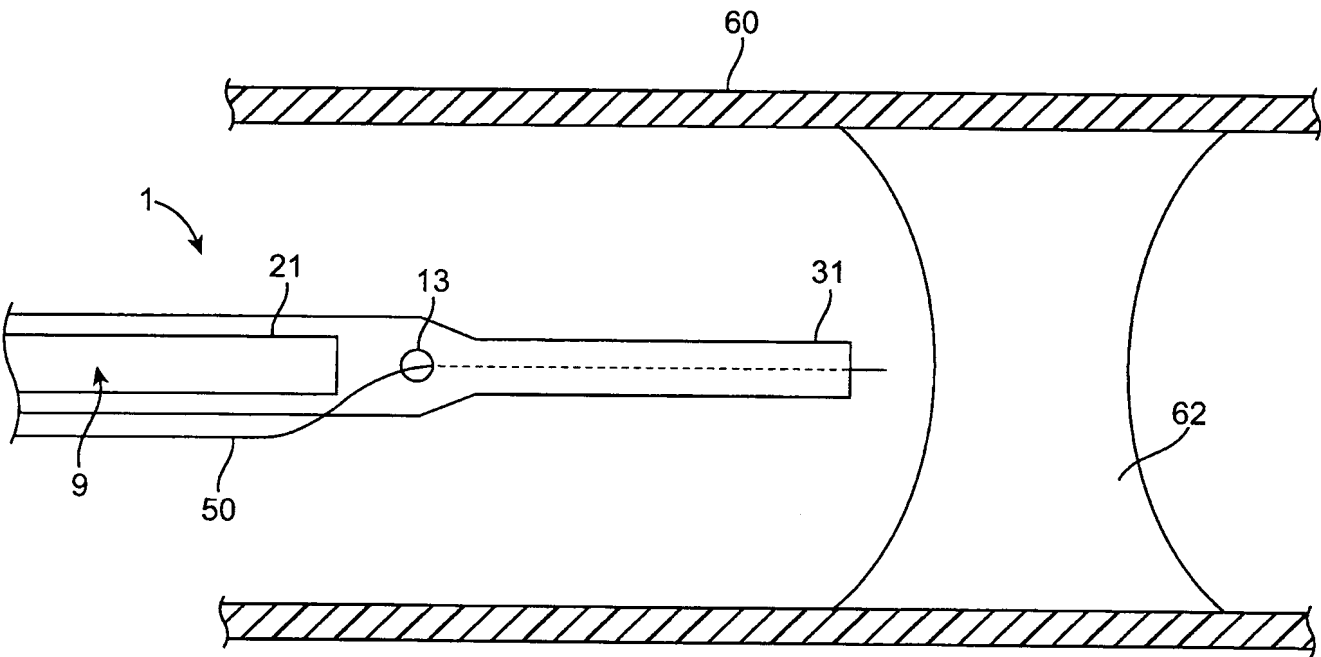


FIG. 5B

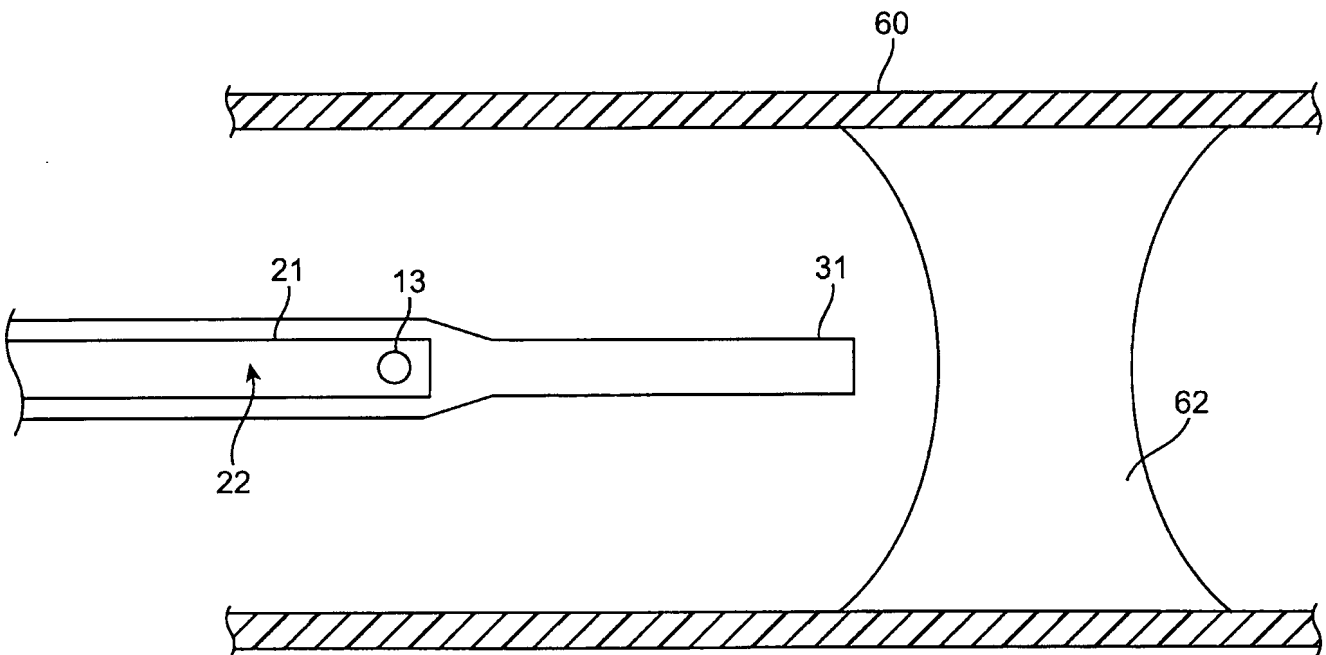


FIG. 5C

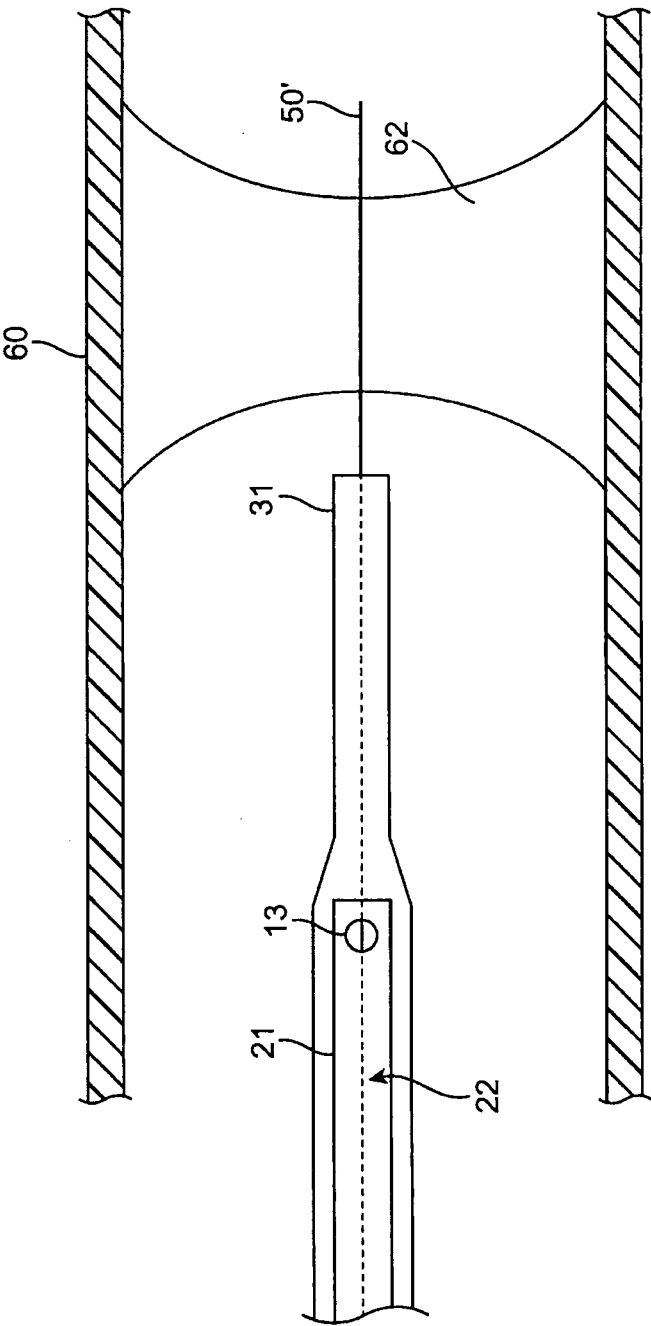


FIG. 5D