

SEPTUM HOUSING FOR A CATHETER

BACKGROUND OF THE INVENTION

[0001] Generally, vascular access devices may be used for communicating fluid with a vascular system of a patient. For example, catheter assemblies may be used for infusing fluid, such as normal saline solution, various medicaments, and total parenteral nutrition, into a patient, withdrawing blood from a patient, or monitoring various parameters of the vascular system of the patient.

[0002] A common type of intravenous (IV) catheter is an over-the-needle peripheral IV catheter. As its name implies, an over-the-needle catheter may be mounted over an introducer needle having a sharp distal tip. At least the inner surface of the distal portion of the catheter tightly may engage the outer surface of the needle to prevent peelback of the catheter and thus facilitate insertion of the catheter into the blood vessel. The catheter and the introducer needle may be assembled so that the distal tip of the introducer needle extends beyond the distal tip of the catheter with the bevel of the needle facing up away from skin of the patient. The catheter and introducer needle are generally inserted at a shallow angle through the skin into a blood vessel.

[0003] In order to verify proper placement of the needle and/or catheter in the blood vessel, the clinician generally confirms that there is “flashback” of blood in a flashback chamber of the catheter assembly. Once placement of the needle has been confirmed, the clinician may temporarily occlude flow in the blood vessel at the catheter tip, remove the needle, leaving the catheter in place, and attach a device to the catheter assembly for fluid removal, input, or to seal the catheter assembly. This process has been somewhat difficult in practice since many placement sites simply do not allow easy occlusion of the target vessel. Additionally, even when such occlusion is achieved, it may be imperfect, thus resulting in blood leaking from the catheter assembly, endangering the medical personnel employing it.

[0004] Catheter and introducer needle assemblies have thus been provided in the art that provide a variety of seals or “septa” for preventing outflow of fluid during and following removal of the introducer needle. Septum dislodgement is often likely to result in fluid leakage. Septum dislodgement and fluid leakage from an IV catheter assembly may occur due to various circumstances. For example, fluid leakage may occur due to pressurization of the system, which may result from venous pressure, fluid injection under high or low pressure, flush of the system, blood collection, *etc.*

BRIEF SUMMARY OF THE INVENTION

[0005] The present application relates to generally to securement of a septum within a catheter assembly to prevent leakage of fluid from the catheter assembly, as well as related systems and methods. In some embodiments, the catheter assembly may include one or more of the following: a catheter, a catheter adapter, a septum housing, and a septum. In some embodiments, the septum may be at least partially disposed within the septum housing and configured to at least substantially seal a lumen of the catheter adapter. In some embodiments, the septum housing may prevent dislodgement or destabilization of the septum, thereby preventing leakage of fluid from the catheter adapter.

[0006] In some embodiments, the catheter assembly may be part of a closed IV catheter system, such as, for example, the BD NEXIVA™ Closed IV Catheter System or the BD NEXIVA™ DIFFUSICS™ Closed IV Catheter System. In the closed IV catheter system, an introducer needle may be withdrawn through the catheter adapter after insertion of the catheter into a blood vessel of a patient. When the introducer needle is withdrawn through the catheter adapter, a “needle channel” may be closed off from an external environment surrounding the catheter system. Further, a side port of the catheter adapter may be connectable to blood withdrawal or infusion means via an extension tube that may extend from the side port of the catheter adapter and may be in fluid communication with the lumen of the catheter adapter. In some embodiments, the septum and/or the septum housing may be disposed proximal to the side port of the catheter adapter.

[0007] In some embodiments, the catheter assembly may be part of another type of catheter system. In some embodiments, the catheter adapter may include a distal end, a proximal end, an inner wall extending between the distal end and the proximal end, and a lumen formed by the inner wall. In some embodiments, the septum housing may be disposed within the lumen of the catheter adapter. In some embodiments, the septum housing may include one or more protrusions. In some embodiments, the one or more protrusions may include a lip. In some embodiments, the septum housing may be secured to the inner wall of the catheter adapter by one or more of the following: an interference fit between the one or more protrusions and the inner wall, a snap fit between the one or more protrusions and the inner wall, bonding between the one or more protrusions and the inner wall, and threading securing the one or more protrusions to the inner wall.

[0008] In some embodiments, the inner wall may include a groove or opening. In some embodiments, the septum housing may be resilient, and in response to the one or more protrusions aligning with the groove or opening, the septum housing may resiliently move

outward to retain the one or more protrusions within the groove or opening in the snap fit. In further detail, in some embodiments, in response to the septum housing being inserted into the distal end of the catheter adapter, the one or more protrusions may be biased inwardly and/or in response to the one or more protrusions being further inserted into the distal end and aligning with the groove or opening, the one or more protrusions move resiliently outward such that the one or more protrusions are retained in the groove or opening.

[0009] In some embodiments, the bonding between the one or more protrusions and the inner wall may include adhesive bonding. Additionally or alternatively, in some embodiments, the bonding between the one or more protrusions and the inner wall may include chemical bonding. Additionally or alternatively, in some embodiments, the bonding between the one or more protrusions and the inner wall may include ultrasonic welding. Additionally or alternatively, in some embodiments, the bonding between the one or more protrusions and the inner wall may include laser welding. Additionally or alternatively, the one or more protrusions may include one or more threads, which may be disposed on a distal end of the septum housing. In some embodiments, the inner wall of the catheter adapter may include corresponding threads to secure the septum housing to the inner wall.

[0010] In some embodiments, the lip may extend around all or a portion of a circumference of the septum housing. In some embodiments, the lip may be disposed at a distal end of the septum housing. In some embodiments, the adhesive bonding and/or the chemical bonding may extend along an exterior of the septum housing proximal to the lip. In some embodiments, the inner wall may include a ring that contacts the exterior of the septum housing proximal to the lip such that a cavity is formed between the ring and the lip. In some embodiments, the cavity may extend around an outer circumference of the septum housing and/or an inner circumference of the catheter adapter. In some embodiments, the cavity may secure the adhesive bonding and/or the chemical bonding.

[0011] In some embodiments, the catheter adapter may include a vent hole that provides a venting pathway between an exterior of the catheter assembly and the adhesive bonding and/or the chemical bonding. In some embodiments, the vent hole and the venting pathway may be used to access the catheter adapter to introduce the adhesive bonding and/or the chemical bonding into the catheter adapter. In some embodiments, the venting pathway may provide access and/or venting to the cavity. In some embodiments, the cavity may include an angled proximal surface, which may facilitate spreading of the adhesive bonding and/or the chemical bonding through the cavity and around the outer circumference of the septum housing.

[0012] In some embodiments, the bonding between the septum housing and the inner wall and/or between the septum and the inner wall may be disposed at various locations on the inner wall. In some embodiments, one or more of the following: adhesive bonding, chemical bonding, ultrasonic welding, and laser welding, may be disposed on all or some surfaces of the inner wall and/or the septum that are in contact. Additionally or alternatively, one or more of the following: adhesive bonding, chemical bonding, ultrasonic welding, and laser welding, may be disposed on all or some surfaces of the inner wall and/or the septum housing that are in contact. In some embodiments, the vent hole may be disposed at various locations within the catheter adapter to provide access to the catheter adapter and/or a venting pathway between the exterior of the catheter assembly and particular adhesive bonding and/or particular chemical bonding. In some embodiments, the vent hole may be disposed proximate to a proximal edge of the lip. In some embodiments, the catheter adapter may comprise a vent hole, and may further comprise port through which the adhesive or chemical bonding material is injected, wherein the vent hole prevents pressure buildup between the septum and/or the septum housing and the inner wall of the catheter adapter during the injection adhesive or chemical bonding material.

[0013] In some embodiments, the one or more protrusions of the septum housing may each include a resilient catch feature. In some embodiments, multiple catch features may be spaced apart about an outer circumference of the septum housing. In some embodiments, an exterior of the catheter adapter may include a safety mechanism engagement feature. In some embodiments, the safety mechanism engagement feature may be spaced apart from the opening in the inner wall. In some embodiments, the safety engagement feature may include a groove configured to selectively couple with a V-clip or similar clip. In some embodiments, the safety engagement feature may be spaced apart from the opening in the inner wall of the catheter adapter.

[0014] In some embodiments, the septum may be housed and retained within the catheter adapter without requiring a mechanical or interference interface with the septum housing. For example, the proximal end of the catheter adapter may abut and extend over a portion of a surface area of a proximal face of the septum, thereby retaining the septum within the catheter adapter. Thus, the catheter adapter may prevent the septum from moving proximally within the catheter adapter due to a wall at the proximal end of the catheter adapter that abuts and thereby partially blocks the proximal end of the catheter adapter.

[0015] In these and other embodiments, the catheter adapter may include at least two pieces. In some embodiments, the catheter adapter may include a proximal piece, a distal

piece, and a lumen extending through the proximal piece and the distal piece. In some embodiments, the proximal piece and the distal piece may be selectively coupled together at a coupling. In some embodiments, the distal piece may include the side port. In some embodiments, the proximal piece may be disposed proximal to the side port. In some embodiments, the proximal and distal pieces may facilitate insertion of the septum into the catheter adapter given the proximal end of the catheter adapter may not include an opening large enough to fit the septum.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0016] In order that the manner in which the above-recited and other features and advantages of the invention are obtained will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof that are illustrated in the appended drawings. These drawings depict only typical embodiments of the invention and are not therefore to be considered to limit the scope of the invention.

[0017] Figure 1A is a cross-sectional top view of an example catheter assembly, according to some embodiments;

[0018] Figure 1B is an enlarged cross-sectional top view of a portion of the catheter assembly of Figure 1A, illustrating example ultrasonic welding, according to some embodiments;

[0019] Figure 1C is an enlarged cross-sectional top view of the portion of the catheter assembly of Figure 1B, illustrating example adhesive bonding, according to some embodiments;

[0020] Figure 1D is an enlarged cross-sectional top view of the portion of the catheter assembly of Figure 1B, illustrating example chemical bonding, according to some embodiments;

[0021] Figure 1E is a partial cutaway top view of an example threads of the catheter assembly of Figure 1A, according to some embodiments;

[0022] Figure 1F is a perspective view of the catheter assembly of Figure 1A, according to some embodiments;

[0023] Figure 1G is an exploded view of the catheter assembly of Figure 1A, according to some embodiments;

[0024] Figure 2 is a cross-sectional view of an example septum and an example septum housing, according to some embodiments;

[0025] Figure 3A is a cross-sectional view of the portion of the catheter assembly of Figure 1B, according to some embodiments;

[0026] Figure 3B is a cross-sectional view of the portion of the catheter assembly of Figure 1B, illustrating example chemical bonding, according to some embodiments;

[0027] Figure 4A is a top view of another example catheter assembly, according to some embodiments;

[0028] Figure 4B is an upper perspective view of an example septum housing, according to some embodiments;

[0029] Figure 4C is a side view of a portion of the catheter assembly of Figure 4A, according to some embodiments;

[0030] Figure 4D is a cross-sectional view of the portion of the catheter assembly of Figure 4C, according to some embodiments;

[0031] Figure 4E is a proximal view of the catheter assembly of Figure 4A, according to some embodiments; and

[0032] Figure 4F is a lower perspective view of the catheter assembly of Figure 4A, illustrating an example safety mechanism securement feature and an example vent hole, according to some embodiments;

[0033] Figure 5A is an upper perspective view of another example septum housing and example septum, according to some embodiments; and

[0034] Figure 5B is a cross-sectional view of the septum housing and the septum of Figure 5A disposed within an example catheter adapter.

DETAILED DESCRIPTION OF THE INVENTION

[0035] The presently preferred embodiments of the present invention can be understood by reference to the drawings, wherein like reference numbers indicate identical or functionally similar elements. It will be readily understood that the components of the present invention, as generally described and illustrated in the figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description, as represented in the figures, is not intended to limit the scope of the invention as claimed, but is merely representative of presently preferred embodiments of the invention.

[0036] Moreover, the Figures may show simplified or partial views, and the dimensions of elements in the Figures may be exaggerated or otherwise not in proportion for clarity. In addition, the singular forms “a,” “an,” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to a terminal includes reference to one or more terminals. In addition, where reference is made to a list of elements

(e.g., elements a, b, c), such reference is intended to include any one of the listed elements by itself, any combination of less than all of the listed elements, and/or a combination of all of the listed elements.

[0037] The term “substantially” means that the recited characteristic, parameter, or value need not be achieved exactly, but that deviations or variations, including for example, tolerances, measurement error, measurement accuracy limitations and other factors known to those of skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide.

[0038] As used herein, the term “proximal”, “top”, “up” or “upwardly” refers to a location on the device that is closest to the clinician using the device and farthest from the patient in connection with whom the device is used when the device is used in its normal operation. Conversely, the term “distal”, “bottom”, “down” or “downwardly” refers to a location on the device that is farthest from the clinician using the device and closest to the patient in connection with whom the device is used when the device is used in its normal operation.

[0039] As used herein, the term “in” or “inwardly” refers to a location with respect to the device that, during normal use, is toward the inside of the device. Conversely, as used herein, the term “out” or “outwardly” refers to a location with respect to the device that, during normal use, is toward the outside of the device.

[0040] Referring now to Figure 1A, in some embodiments, a catheter assembly 10 may include one or more of the following: a catheter 12, a catheter adapter 14, a septum housing 16, and a septum 18. In some embodiments, the catheter adapter 14 may include a distal end 20, a proximal end 22, an inner wall 24 extending between the distal end 20 and the proximal end 22, and a lumen 26 formed by the inner wall 24. In some embodiments, the septum housing 16 may be disposed within the lumen 26 of the catheter adapter 14.

[0041] In some embodiments, the septum 18 may be at least partially disposed within the septum housing 16 and configured to at least substantially seal the proximal end 22 and/or a lumen of the catheter adapter 14. In some embodiments, the septum housing 16 may prevent dislodgement or destabilization of the septum 18, thereby preventing leakage of fluid from the catheter adapter.

[0042] In some embodiments, the catheter assembly 10 may be part of a closed IV catheter system, such as, for example, the BD NEXIVA™ Closed IV Catheter System, the BD NEXIVA™ DIFFUSICS™ Closed IV Catheter System, the BD Intima II™ Catheter, or similar catheter systems. In some embodiments, the catheter assembly may be part of another

type of catheter system. In the closed IV catheter system, an introducer needle (not illustrated in Figure 1A) may be withdrawn through the catheter adapter 14 after insertion of the catheter 12 into a blood vessel of a patient. When the introducer needle is withdrawn through the catheter adapter 14, a “needle channel” may be closed off from an external environment surrounding the catheter assembly 10. Further, a side port 28 of the catheter adapter 14 may be connectable to blood withdrawal or infusion means via an extension tube that may extend from the side port 28 of the catheter adapter and may be in fluid communication with the lumen 26 of the catheter adapter 10. In some embodiments, the septum 18 and/or the septum housing 16 may be disposed proximal to the side port 28 of the catheter adapter 14.

[0043] Referring now to Figure 1B, in some embodiments, the septum housing 16 may include one or more protrusions. In some embodiments, the septum housing may be secured to the inner wall 24 of the catheter adapter 14 by one or more of the following: an interference fit between the one or more protrusions and the inner wall 24, a snap fit between the one or more protrusions and the inner wall 24, and bonding between the one or more protrusions and the inner wall 24.

[0044] In some embodiments, the inner wall 24 may include a groove 30 or opening (an example opening 70 is illustrated in Figures 4A and 4C-4D). It is understood that the inner wall 24 may include multiple grooves 30 and/or multiple openings and that each of the multiple grooves and/or the multiple openings may be configured to retain one or more of the protrusions. In some embodiments, the septum housing 16 may be resilient, and in response to the one or more protrusions aligning with the groove 30 or opening, the septum housing 16 may resiliently move outward to retain the one or more protrusions within the groove 30 or opening in the snap fit. In further detail, in some embodiments, in response to the septum housing 16 being inserted into the proximal end 22 of the catheter adapter 14, the one or more protrusions may be biased inwardly and/or in response to the one or more protrusions being further inserted into the proximal end 22 and aligning with the groove 30 or opening, the one or more protrusions move resiliently outward such that the one or more protrusions are retained within the groove 30 or opening.

[0045] In some embodiments, when the one or more protrusions are aligned with the groove 30 in the snap fit, the one or more protrusions may be disposed in an interference fit with the groove 30. As interference between the septum housing 16 and the catheter adapter 14 increases, there may be an increased probability and/or severity of deformation of the septum 18 and/or other components of the catheter assembly 10. As interference between the septum housing 16 and the catheter adapter 14 increases, there may also be an increased

likelihood of stress-induced crazing of the septum housing 18, the catheter adapter 14 and/or other components of the catheter assembly 10. In some embodiments, the interference fit between the one or more protrusions and the groove 30 may facilitate avoidance of the deformation and/or the stress-induced crazing while still providing support against dislodgement or destabilization of the septum 18. In some embodiments, a lubricant, such as, for example, alcohol or silicone, may be used for uniform seating of the septum within the septum housing 16 and/or the catheter adapter 14. The lubricant may also reduce stress-induced crazing. The lubricant may also increase a maximum pressure performance, which may include a maximum amount of pressure that can be applied to the septum 18 and/or the septum housing 16 without significant dislodgement of the septum 18 as the introducer needle is withdrawn. In some embodiments, an alcohol lubricant may increase the maximum pressure performance more than a silicone lubricant.

[0046] In some embodiments, the one or more protrusions of the septum housing may include a lip 34. In some embodiments, the lip 34 may extend around all or a portion of a circumference of the septum housing 16. In some embodiments, the lip 34 may be disposed at a distal end of the septum housing 16. In some embodiments, the interference fit between the lip 34 and the groove 30 may be tighter due to the lip 34 being enlarged. An enlarged size of the lip 34 may increase the maximum pressure performance. In some embodiments, the lip 34 may provide better interference and greater maximum pressure performance than multiple protrusions, which may be spaced apart and not extend around an entire circumference of the septum housing 16.

[0047] In some embodiments, the bonding between the one or more protrusions and the inner wall may include ultrasonic welding 32. In some embodiments, the ultrasonic welding 32 may increase the maximum pressure performance. In some embodiments, laser welding may be used instead of or in addition to the ultrasonic welding 32. In some embodiments, a premixed resin or colorant may be applied in a location of the laser welding and/or the ultrasonic welding 32, which may create uniform transmissivity resulting in more consistent weld performance.

[0048] In some embodiments, the laser welding and/or the ultrasonic welding 32 may be configured not to fail a minimum threshold energy to facilitate adhesion or a maximum threshold energy to avoid damaging any components of the catheter assembly 10, such as, for example, the septum 18, the septum housing 16, and the catheter adapter 14.

[0049] In some embodiments, the bonding between the septum housing 16 and the inner wall 24 and/or between the septum 18 and the inner wall 24 may be disposed at various

locations on the inner wall 24. In some embodiments, the ultrasonic welding 32 may be disposed where the inner wall 24 contacts the septum 18 and/or the septum housing 16. In some embodiments, the inner wall 24 may include one or more other protrusions or a ring 36. In some embodiments, the one or more other protrusions or the ring 36 may form a proximal edge of the groove 30. In some embodiments, the ultrasonic welding 32 may be disposed between the one or more other protrusions or the ring 36 and an external surface of the septum housing 16, as illustrated in Figure 1B.

[0050] Referring now to Figure 1C, in some embodiments, the bonding between the one or more protrusions and the inner wall 24 may include adhesive bonding 38. In some embodiments, the adhesive bonding 38 may include glue or another adhesive. In some embodiments, the adhesive bonding 38 may extend along an exterior of the septum housing 16 proximal to the lip 34. In some embodiments, the ring 36 may contact the exterior of the septum housing 16 proximal to the lip 34 such that a cavity is formed between the ring 36 and the lip 34. In some embodiments, the cavity may extend around an outer circumference of the septum housing 16 and/or an inner circumference of the catheter adapter 14. In some embodiments, the multiple cavities may be formed between the one or more protrusions of the septum housing 16 and the one or more other protrusions of the catheter adapter 14.

[0051] In some embodiments, the catheter adapter 14 may include one or more vent holes 40 that provide venting pathways between an exterior environment of the catheter assembly 14 and the adhesive bonding 38 and/or the chemical bonding (illustrated in Figure 1D). In some embodiments, the vent holes 40 and their corresponding venting pathways may be used to access the catheter adapter 14 to introduce the adhesive bonding 38 and/or the chemical bonding into the catheter adapter 14, such as, for example, into the cavity of the catheter adapter 14. In some embodiments, the venting pathways may each provide access and/or venting to the cavity. In some embodiments, the cavity may include an angled proximal surface 42, which may facilitate spreading of the adhesive bonding 38 and/or the chemical bonding through the cavity and around the outer circumference of the septum housing 16.

[0052] In some embodiments, the vent holes 40 may be disposed at various locations within the inner wall 24 of the catheter adapter 14 to provide access to the catheter adapter 14 and/or a venting pathway between the exterior of the catheter assembly 10 and particular adhesive bonding 38 and/or particular chemical bonding. In some embodiments, a particular vent hole 40 may be disposed proximate to a proximal edge of the lip 34.

[0053] In some embodiments, the ring 36 may include a retention ring or washer that may be placed around the lip 34 or another portion of the septum housing 16. In some

embodiments, the adhesive bonding 38 may be disposed between the retention ring and the inner wall 24.

[0054] Referring now to Figure 1D, in some embodiments, the bonding between the one or more protrusions and the inner wall 34 may include solvent or chemical bonding 44. In some embodiments, the chemical bonding 44 may be disposed where the inner wall 24 contacts the septum 18 and/or the septum housing 16.

[0055] Referring now to Figure 1E, in some embodiments, the one or more protrusions may include one or more threads 46, which may be disposed on a distal end of the septum housing 16. In some embodiments, the inner wall 24 of the catheter adapter 14 may include corresponding threads 48 to secure the septum housing 16 to the inner wall 24.

[0056] Referring now to Figure 1F, in some embodiments, an extension tube 50 is connected to the side port 28. In some embodiments, the catheter assembly 10 may include a needle hub 52. In some embodiments, a proximal end of the introducer needle 54 may be connected to the needle hub 52. In some embodiments, the needle hub 52 may include a needle shielding mechanism.

[0057] Referring now to Figure 1G, in some embodiments, the septum 18 may be formed from two portions, a proximal portion 18a and a distal portion 18b. In some embodiments, each of the portions 18a, 18b may be pre-slit to facilitate locating the introducer needle 54 therethrough. Suitable materials for the septum 18 may include a peroxide cured elastomer such as polyisoprene, silicone, and the like where the materials have a durometer in the range of 35-45 Shore A.

[0058] In some embodiments, the septum housing 16 may be constructed of a resilient material. Non-limiting examples of resilient material include stainless steel, polyethylene, polypropylene, polycarbonate, polyethylene terephthalate (PET), polyethylene terephthalate glycol-modified (PETG), and polyester. In some embodiments, the catheter adapter 14 may be constructed of a same or similar material as the septum housing 16 to facilitate strength of the bonding between the catheter adapter 14 and the septum housing 16.

[0059] In some embodiments, the septum housing 16 may have an open proximal end and an open distal end. In some embodiments, the septum housing 16 may surround at least a portion of the proximal portion 18a and the distal portion 18b in an interference fit to hold the septum 18 in place in position in the catheter adapter 14. In some embodiments, the septum housing 16 may extend along only a portion of the distal portion 18b. However, in some embodiments, the septum housing 16 may extend along an entire length of the septum 18 or

just along the proximal portion 18a. In some embodiments, at least a portion of the septum 18 may engage the inner wall 24.

[0060] In some embodiments, the septum housing 16 may be configured to apply a compressive force to the septum 18. In some embodiments, the open proximal and distal ends of the septum housing 16 may allow the introducer needle 54 to extend through the septum 18 past the septum housing 16. In some embodiments, the proximal end of the septum housing 16 may abut and extend over a portion of a surface area of a proximal face of the septum 18.

[0061] In some embodiments, the septum 18 may be a low-drag septum, which may facilitate stability and uniformity of the septum 18 during insertion of the catheter assembly 10 into the blood vessel of the patient. Referring back to Figure 1B, in some embodiments, the septum 18 may include a hollow interior portion 56 formed between the proximal portion 18a and the distal portion 18b. The hollow interior portion 56 may minimize drag on introducer needle 54 as it is being withdrawn from catheter assembly 10.

[0062] In some embodiments, an external diameter of at least a portion of the distal portion 18b may be greater than an internal diameter of catheter adapter 14. In some embodiments, the external diameter of the distal portion 18b may be at least 5% larger than the internal diameter of the relevant portion of catheter adapter 14. With this configuration, the catheter adapter 14 may exert a radial compressive force against the distal portion 18b. This compressive force may help to hold the septum housing 16 in place.

[0063] Although illustrated in Figure 1G as a low-drag, two-piece septum 18, the septum 18 may include various types of septa. For example, referring now to Figure 2, in some embodiments, the septum 18 may be formed from one piece. In some embodiments, the one piece septum may be low-drag. In some embodiments, the septum 18 may be self-retaining, for example, the septum 18 may be at least partially retained within the septum housing 16 and/or the catheter adapter 14 by means of an interference or friction fit between the septum 18 and the inner wall 24, a mass of the septum 18, *etc.*

[0064] In some embodiments, the septum housing 58 may include or correspond to the septum housing 16. In some embodiments, a length of the septum housing 58 may be less than a length of the septum housing 16. The septum housing 58 may be secured to the inner wall 24 of the catheter adapter 14 similar to the septum housing 16. For example, the septum housing 58 may be secured to the inner wall 24 by one or more of the following: an interference fit between the one or more protrusions and the inner wall 24, a snap fit between

the one or more protrusions and the inner wall 24, and bonding between the one or more protrusions and the inner wall 24.

[0065] Referring now to Figure 3A, in some embodiments, the septum 18 may be housed by the catheter adapter 14 without use of a particular septum housing, such as, for example, the septum housing 16 of Figure 1 or the septum housing 58 of Figure 2. For example, the proximal end of the catheter adapter 14 may abut and extend over a portion of a surface area of a proximal face of the septum 18. Thus, the catheter adapter 14 may prevent the septum 18 from moving proximally within the catheter adapter 14 due to a wall at the proximal end of the catheter adapter 14 that abuts the proximal end of the catheter adapter 14.

[0066] In some embodiments, the catheter adapter 14 may include at least two pieces. In some embodiments, the catheter adapter 14 may include a proximal piece 60, a distal piece 62, and the lumen 26 extending through the proximal piece 60 and the distal piece 62. In some embodiments, the proximal piece 60 and the distal piece 62 may be selectively coupled together at a coupling 63. In some embodiments, the distal piece 62 may include the side port 28. In some embodiments, the proximal piece 60 may be disposed proximal to the side port 28. In some embodiments, the proximal and distal pieces 60, 62 may facilitate insertion of the septum 18 into the catheter adapter 14 during assembly of the catheter assembly 10 given that the proximal end of the catheter adapter 14 may not include an opening large enough to fit the septum 18.

[0067] Referring now to Figure 3B, in some embodiments, the septum 18 may be secured to the inner wall of the catheter adapter 14 by bonding 65 between the septum 18 and the inner wall. The bonding may include one or more of the following: the adhesive bonding 38 described in the present disclosure, the chemical bonding 44 described in the present disclosure, or another suitable type of bonding. In some embodiments, the bonding may be disposed along at least a portion of a length of the septum 18.

[0068] Referring now to Figure 4A-4F, in some embodiments, a catheter assembly 64 may include or correspond to the catheter assembly 10. In some embodiments, the one or more protrusions of the septum housing 16 may each include a resilient catch feature 66. In some embodiments, multiple catch features 66 may be spaced apart about an outer circumference of the septum housing 16. In some embodiments, the spacing of the catch features 66 may allow the septum housing 16 to be inserted through a proximal opening in the proximal end 22 without regard to orientation.

[0069] In some embodiments, an exterior of the catheter adapter 14 may include a safety mechanism engagement feature 68. In some embodiments, the safety mechanism engagement

feature 68 may be spaced apart from the opening 70 in the inner wall 24. In some embodiments, the safety engagement feature 68 may include a groove configured to selectively couple with a V-clip or similar clip (not illustrated in Figures 4A-4F). In some embodiments, the safety engagement feature 68 may be spaced apart from the opening 70 in the inner wall of the catheter adapter 14. In some embodiments, the safety engagement feature 68 may be disposed on an opposite side of the catheter adapter 14 as the opening 70. In some embodiments, a particular vent hole 40 may be aligned with and/or disposed within the safety engagement feature 68, as illustrated in Figure 4F. Although the septum illustrated in Figures 4A-4F is a two-piece septum 18, in some embodiments, a one-piece septum 18 may be used.

[0070] Referring now to Figures 5A-5B, in some embodiments, a catheter assembly 71 may include or correspond to the catheter assembly 10 or the catheter assembly 64. As illustrated in Figure 5A, in some embodiments, the one or more protrusions of the septum housing 16 may include one or more catch features 72 disposed on one or more arms of the septum housing 16, which may be constructed of a resilient material. In some embodiments, the septum housing 16 may include two of the catch features 72, which may be disposed on opposite sides of the septum housing 16. In some embodiments, each of the arms may be connected to a body of the septum housing 16 at a base on the corresponding arm opposite the catch feature 72. In some embodiments, each of the arms may be spaced apart and/or separated from the body of the septum housing 16 along one or both sides of the arm and/or at an end of the arm opposite the base.

[0071] In some embodiments, in response to the septum housing 16 being inserted into the distal end of the catheter adapter 14, the catch features 72 and the arms may be biased inwardly. In some embodiments, in response to catch features 72 being further inserted into the distal end and aligning with one or more grooves and/or openings 70, the catch features 72 and arms may move resiliently outward such that the catch features 72 are retained in the grooves and/or the openings 70 in a snap fit.

[0072] In some embodiments, the catheter adapter 14 may include any suitable number of grooves or openings 70, which may each be configured to retain one or more of the retention features 72. As illustrated in Figure 1B, in some embodiments, the catheter adapter 14 may include two openings 70 which may be disposed on opposite sides of the catheter adapter 14. In some embodiments, each of the openings 70 may be configured to retain at least one of the catch features 72.

[0073] The present invention may be embodied in other specific forms without departing from its structures, methods, or other essential characteristics as broadly described herein and claimed hereinafter. The described embodiments are to be considered in all respects only as illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

The invention claimed is:

1. A catheter assembly, comprising:

a catheter adapter, wherein the catheter adapter comprises a distal end, a proximal end, an inner wall extending between the distal end and the proximal end, and a lumen formed by the inner wall;

a septum housing disposed within the lumen of the catheter adapter, wherein the septum housing comprises one or more protrusions, wherein the one or more protrusions comprise a lip that extends around an outer circumference of the septum housing, wherein the septum housing is secured to the inner wall by bonding between the one or more protrusions and the inner wall, wherein the bonding between the one or more protrusions and the inner wall comprises adhesive bonding, wherein the inner wall comprises a ring that contacts an exterior of the septum housing and is spaced apart from the lip such that a cavity is formed between the ring and

the lip, wherein the adhesive bonding contacts the ring, wherein a venting pathway provides access to the cavity; and

a septum at least partially disposed within the septum housing and configured to at least substantially seal the lumen.

2. The catheter assembly of claim 1, wherein the inner wall comprises a groove, wherein in response to the one or more protrusions aligning with the groove, the septum housing resiliently moves outwardly to retain the one or more protrusions within the groove in the snap fit.

3. The catheter assembly of claim 1, wherein the catheter adapter further comprises a vent hole that provides the venting pathway between an exterior of the catheter assembly and the adhesive bonding.

4. The catheter assembly of claim 1, wherein the cavity comprises an angled proximal surface.

5. The catheter assembly of claim 1, wherein the bonding between the one or more protrusions and the inner wall comprises chemical bonding, wherein the chemical bonding is disposed where the inner wall contacts the septum and the septum housing.

6. A catheter assembly, comprising:

- a catheter adapter, wherein the catheter adapter comprises a distal end, a proximal end, an inner wall extending between the distal end and the proximal end, a lumen formed by the inner wall, and a side port, wherein the inner wall comprises a groove or opening;
- a septum housing disposed within the lumen of the catheter adapter, wherein the septum housing comprises one or more protrusions, wherein in response to the septum housing being inserted into the distal end of the catheter adapter, the one or more protrusions are biased inwardly, wherein in response to the one or more protrusions being further inserted into the distal end and aligning with the groove or opening, the one or more protrusions move resiliently outward such that the one or more protrusions are retained in the groove or opening, wherein the one or more protrusions comprise a lip that extends around an outer circumference of the septum housing, wherein the septum housing is secured to the inner wall by bonding between the one or more protrusions and the inner wall, wherein the inner wall comprises a ring that contacts an exterior of the septum housing and is spaced apart from the lip such that a cavity is formed between the ring and the lip, wherein the bonding contacts the ring;
- a vent hole disposed within the inner wall of the catheter adapter, wherein the vent hole provides a venting pathway between an exterior of the catheter assembly and the bonding; and
- a septum at least partially disposed within the septum housing and proximal to the side port, wherein the septum is configured to at least substantially seal the lumen.

7. The catheter assembly of claim 6, wherein the septum housing is secured to the inner wall by bonding between the one or more protrusions and the inner wall.

8. The catheter assembly of claim 7, wherein the bonding between the one or more protrusions and the inner wall comprises chemical bonding, wherein the chemical bonding is disposed where the inner wall contacts the septum and the septum housing.

9. The catheter assembly of claim 7, wherein the groove or opening is a groove, wherein the bonding between the one or more protrusions and the inner wall comprises adhesive bonding, wherein the adhesive bonding extends along the

exterior of the septum housing proximal to the one or more protrusions, wherein the catheter adapter.

10. The catheter assembly of claim 9, wherein the vent hole is disposed proximate to a proximal edge of the lip.