[0047] Figure 27 is a perspective view of a catheter tip having a hole with a proximally-inclined proximal surface and a tear-shaped outer opening in accordance with a representative embodiment of the present invention.

[0048] Figure 28A is a top view of the catheter tip of Figure 27.

[0049] Figure 28B is a cross sectional view of the catheter tip of Figure 28B, taken along line 24B, as it passes through human tissue.

[0050] Figure 28C is a cross sectional view of the catheter tip of Figure 28C, taken along line 24C, as it passes through human tissue.

[0051] Figure 29 is a perspective view of a catheter tip having a hole with a curved proximal surface in accordance with a representative embodiment of the present invention.

[0052] Figure 30 is a perspective view of a catheter tip having a hole with a rounded proximal surface in accordance with a representative embodiment of the present invention.

[0053] Figure 31 is a cross sectional view of Figure 30.

[0054] Figure 32 is a perspective view of a catheter tip having a hole with a proximally-inclined proximal surface with an inward projection in accordance with a representative embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0055] Embodiments of the present invention will be best 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.

[0056] The systems and methods of the present invention are generally designed for use in combination with a vascular infusion system capable of rapidly delivering an infusant to the vascular system of a patient. Referring now to Figure 1, a vascular infusion system 100 is shown, in accordance with a representative embodiment of the present invention. Infusion systems of this type are commonly configured to operate at internal pressures up to 13789.5 kPa (2000 psi). Many systems operate in the range of 517.1 to 13789.5 kPa (75 to 2000 psi), while specific devices of this type operate at 689.5, 1379.0, and 2068.4 kPa (100, 200, and 300 psi). The vascular infusion system 100 comprises a vascular access device 112 coupled to an injector pump 120 via a coiled extension set 130. In some embodiments, the infusion system 100 further comprises a safety device 140 positioned between the vascular access device 112 and the injector pump 120. In some embodiments, a

CLAIMS

1. A catheter, comprising:

a catheter body consisting of a single lumen having an inner diameter and a constant outer diameter;

a tapered tip coupled to a distal end of the catheter body and having a single distal lumen opening, the single lumen of the catheter body extending through the catheter body and the tapered tip along a longitudinal axis of the catheter body;

a hole formed through a wall of at least a portion of the tapered tip and having a width that is less than the inner diameter of the single lumen; and

a portion of a proximal surface of the hole being inclined at an acute angle with respect to the longitudinal axis of the catheter body, the acute angle opening proximally with respect to the catheter body.

2. The catheter of claim 1, wherein the acute angle is between 20° and 80°.

3. The catheter of claim 1, further comprising a distal surface of the hole being inclined at an acute angle with respect to the longitudinal axis of the catheter body, the acute angle opening distally with respect to the catheter body.

4. The catheter of claim 3, wherein the acute angle of the distal surface of the hole is between about 20° and about 90°.

5. The catheter of claim 1, further comprising:

a second hole formed through a wall on a distal portion of the catheter body;

a portion of a proximal surface of the second hole being inclined at an acute angle with

respect to the longitudinal axis of the catheter body, the acute angle of the second hole opening proximally with respect to the catheter body.

6. The peripheral catheter of claim 1, wherein the hole has a substantially D-shaped inner opening.

7. The peripheral catheter of claim 1, wherein the proximal surface of the hole is substantially planar.

8. The peripheral catheter of claim 1, further comprising a tapered tip coupled to a distal end of the catheter body, wherein the hole is at least partially disposed on the tapered tip.

9. The catheter of claim 1, wherein the catheter is a peripheral catheter having a truncated length sufficient to access a peripheral vein of a patient and an outer diameter less than or equal to that of a twelve gauge catheter.

10. A peripheral catheter, comprising:

a catheter body having a single lumen extending through the catheter body along a longitudinal axis of the catheter body and having an inner diameter, the catheter body having a constant outer diameter and further having a truncated length sufficient to access a peripheral vein of a patient;

a tapered tip coupled to a distal end of the catheter body and having a single distal lumen opening in communication with the single lumen;

two or more holes formed through a wall of the tapered tip, the two or more holes each having a width that is less than the inner diameter of the single lumen;

a proximal surface of the two or more holes being inclined at a first acute angle with respect to the longitudinal axis of the catheter body, the first acute angle opening proximally with respect to the catheter body; and

a distal surface of the two or more holes being inclined at a second acute angle with respect to the longitudinal axis of the catheter body, the second acute angle opening distally with respect to the catheter body.

11. The catheter of claim 10, wherein at least one of the first and second acute angles is between about 20° and about 80°.

12. The peripheral catheter of claim 10, wherein the two or more holes have substantially D-shaped inner openings.

13. A peripheral intravenous catheter, comprising:

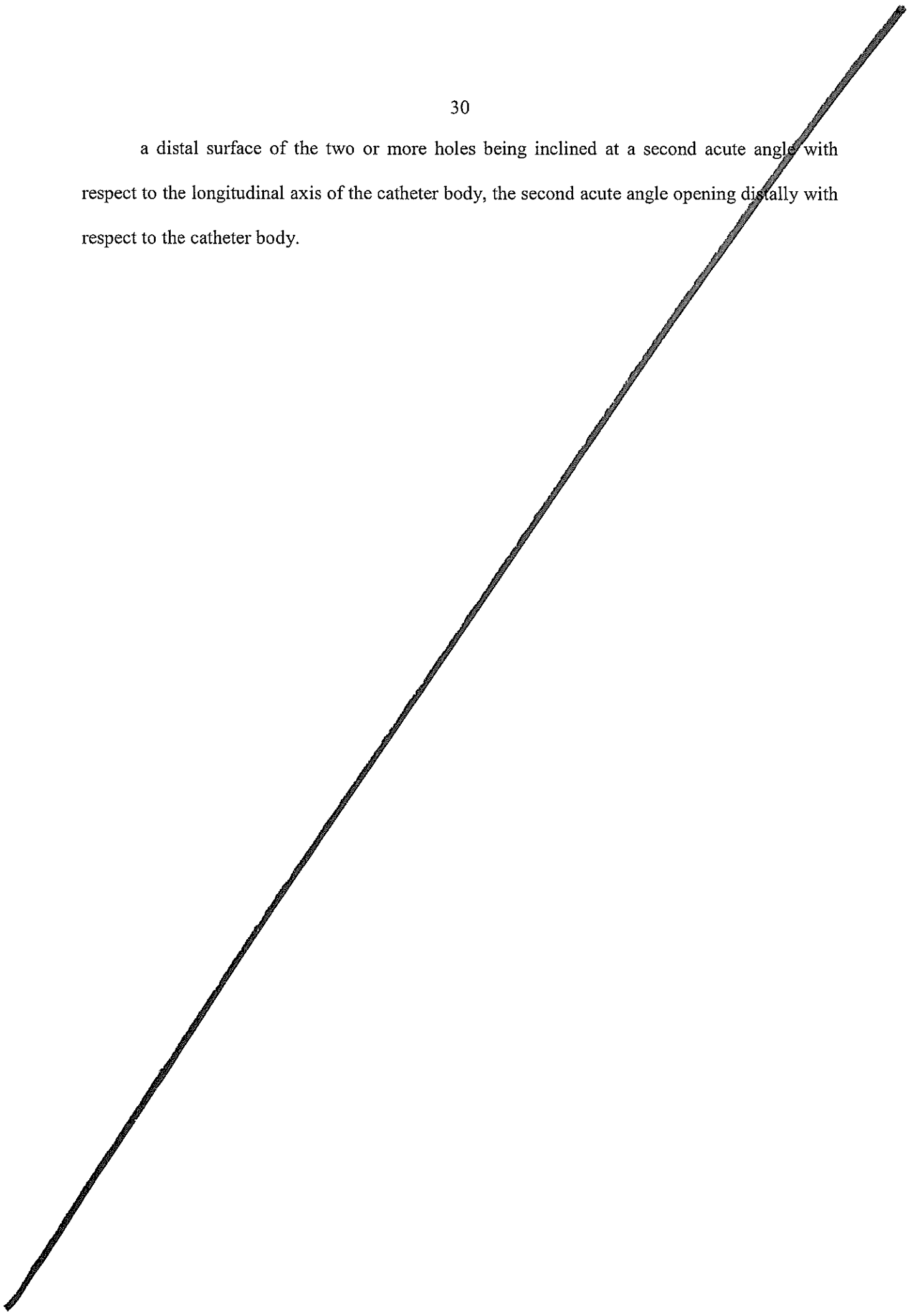
a catheter body having a single lumen extending through the catheter body along a longitudinal axis of the catheter body, the catheter body further having a truncated length sufficient to access a peripheral vein of a patient;

a tapered tip coupled to a distal end of the catheter body and having a single distal lumen opening in communication with the single lumen;

two or more holes formed through a wall of the tapered tip and a portion of at least one of the two or more holes being formed in the catheter body, and each of the two or more holes having a width that is less than a diameter of the single lumen;

a proximal surface of the two or more holes being inclined at a first acute angle between about 20° and about 80° with respect to the longitudinal axis of the catheter body, the first acute angle opening proximally with respect to the catheter body; and

a distal surface of the two or more holes being inclined at a second acute angle with respect to the longitudinal axis of the catheter body, the second acute angle opening distally with respect to the catheter body.



CLAIMS

1. A catheter, comprising:

a catheter body consisting of a single lumen having an inner diameter;

a tapered tip coupled to a distal end of the catheter body and having a single distal lumen opening, the single lumen of the catheter body extending through the catheter body and the tapered tip along a longitudinal axis of the catheter body;

a hole formed through at least a portion of the tapered tip and having a width that is less than the inner diameter of the single lumen, the hole including a proximal surface that extends from an outer surface of the catheter body or the tapered tip to the inner diameter of the single lumen, the proximal surface being flat and inclined at a first acute angle with respect to the longitudinal axis of the catheter body, the first acute angle opening proximally with respect to the catheter body, the hole also including a distal surface that extends from the outer surface of the catheter body or the tapered tip to the inner diameter of the single lumen, the distal surface being inclined at a second acute angle with respect to the longitudinal axis of the catheter body, the second acute angle opening distally with respect to the catheter body.

2. The catheter of claim 1, wherein the first and second acute angles are between 20° and 80°.

3. The catheter of claim 1, wherein an inner edge of the proximal surface is straight.

4. The catheter of claim 1, wherein an inner edge of the proximal surface is curved.

5. The catheter of claim 1, further comprising:

a second hole formed through the catheter body, the second hole including a proximal surface that extends from an outer surface of the catheter body to the inner diameter of the single lumen, the proximal surface being flat and inclined at an acute angle with respect to the longitudinal axis of the catheter body, the acute angle opening proximally with respect to the catheter body.

6. The peripheral catheter of claim 1, wherein the distal surface is curved.

7. The catheter of claim 1, wherein the proximal surface is triangular.

8. The catheter of claim 7, wherein an inner edge of the proximal surface is straight.

9. The catheter of claim 7, wherein an inner edge of the proximal surface is curved.

10. The peripheral catheter of claim 1, wherein an inner edge of the proximal surface is rounded.

11. The peripheral catheter of claim 1, wherein the distal surface is flat.

12. The catheter of claim 1, wherein the catheter is a peripheral catheter having a truncated length sufficient to access a peripheral vein of a patient and an outer diameter less than or equal to that of a twelve gauge catheter.

13. The catheter of claim 1, wherein the distal surface includes an inward projection.

14. A peripheral catheter, comprising:

a catheter body having a single lumen extending through the catheter body along a longitudinal axis of the catheter body and having an inner diameter, the catheter body having a constant outer diameter and further having a truncated length sufficient to access a peripheral vein of a patient;

a tapered tip coupled to a distal end of the catheter body and having a single distal lumen opening in communication with the single lumen;

two or more holes formed through a wall of the tapered tip, the two or more holes each having a width that is less than the inner diameter of the single lumen;

each hole including a proximal surface that extends from an outer surface of the catheter body or the tapered tip to the inner diameter of the single lumen and that is flat and inclined at a

first acute angle with respect to the longitudinal axis of the catheter body, the first acute angle opening proximally with respect to the catheter body; and

each hole also including a distal surface that extends from the outer surface of the catheter body or the tapered tip to the inner diameter of the single lumen and that is inclined at a second acute angle with respect to the longitudinal axis of the catheter body, the second acute angle opening distally with respect to the catheter body.

15. The catheter of claim 14, wherein at least one of the first and second acute angles is between about 20° and about 80°.

16. The peripheral catheter of claim 14, wherein an inner edge of one or both of the proximal surfaces is straight.

17. A peripheral intravenous catheter, comprising:

a catheter body having a single lumen extending through the catheter body along a longitudinal axis of the catheter body, the catheter body further having a truncated length sufficient to access a peripheral vein of a patient;

a tapered tip coupled to a distal end of the catheter body and having a single distal lumen opening in communication with the single lumen;

two or more holes formed through a wall of the tapered tip and a portion of at least one of the two or more holes being formed in the catheter body, and each of the two or more holes having a width that is less than a diameter of the single lumen;

each hole including a proximal surface that extends from an outer surface of the catheter body to the inner diameter of the single lumen and that is flat and inclined at a first acute angle between about 20° and about 80° with respect to the longitudinal axis of the catheter body, the first acute angle opening proximally with respect to the catheter body; and

each hole also including a distal surface that extends from an outer surface of the tapered tip to the inner diameter of the single lumen and that is inclined at a second acute angle with respect to the longitudinal axis of the catheter body, the second acute angle opening distally with respect to the catheter body.

18. The peripheral catheter of claim 14, wherein an inner edge of one or both of the proximal surfaces is curved.

19. The peripheral catheter of claim 14, wherein one or both of the distal surfaces are curved.

20. The peripheral catheter of claim 14, wherein an inner edge of one or both of the proximal surfaces are rounded.