

ARROW®

Percutaneous Sheath Introducer Product with ARROWgard® Antimicrobial Surface and Single-Lumen Infusion Catheter (SLIC®)

Safety and Efficacy Considerations:

Do not use if package has been previously opened or damaged.

Warning: Prior to use read all package insert warnings, precautions, and instructions. Failure to do so may result in severe patient injury or death.

The product is designed for single use only. Do not resterilize or reuse. Do not alter sheath or any other kit/set component during insertion, use, or removal.

Procedure must be performed by trained personnel well versed in anatomical landmarks, safe technique, and potential complications.

ARROWgard® Antimicrobial Surface: The Arrow® antimicrobial sheath consists of our standard polyurethane sheath plus an exterior antimicrobial surface treatment. Substantial antimicrobial activity associated with the 7 Fr. triple-lumen ARROWgard Blue® catheter and/or sheath has been demonstrated in the following ways:

- Significant antimicrobial activity associated with the ARROWgard® antimicrobial surface has been demonstrated using zone of inhibition bioassays against the following organisms²⁵:

Escherichia coli
Pseudomonas aeruginosa
Staphylococcus epidermidis
Staphylococcus aureus
Klebsiella pneumoniae
Candida albicans

- Contact inhibition of microbial growth on the surface has been demonstrated against organisms commonly associated with nosocomial infections; e.g. *Staphylococcus epidermidis* and *Staphylococcus aureus*.²⁵
- Antimicrobial activity on the surface during handling and placement has been demonstrated *in situ* in limited animal studies.¹⁴
- The ARROWgard Blue® catheter has demonstrated a significant decrease in the rate of bacterial colonization along the catheter in limited animal studies.¹⁴
- A prospective randomized clinical trial of 403 catheter insertions in adult patients in a medical-surgical ICU showed that the antimicrobial catheters were 50% less likely to be colonized than control catheters (p=0.003) and 80% less likely to produce catheter related bacteremia (p=0.02).²³
- Arrow® antimicrobial catheters retained antibacterial activity with zones of inhibition of 4 to 10 mm against *Staphylococcus aureus* and *Escherichia coli* after 10 days of implantation in rats.²⁵
- Complete data was obtained for 403 catheters (195 control catheters and 208 antimicrobial catheters) in 158 patients. Control catheters removed from patients who were receiving systemic antibiotic therapy occasionally showed low-level surface activity that was unrelated to the length of time the catheter had been in place (mean zone of inhibition ± SD,

1.7 ± 2.8 mm); in contrast, antimicrobial catheters uniformly showed residual surface activity (mean zone of inhibition, 5.4 ± 2.2 mm; P < 0.002), which declined after prolonged periods *in situ*. Antimicrobial activity was seen with antimicrobial catheters that had been in place for as long as 15 days.²³

- Arrow® antimicrobial catheters produced large zones of inhibition *in vitro* (range 10 to 18 mm) against the following microbes:

Methicillin-resistant *Staphylococcus aureus*
Gentamicin/methicillin-resistant *Staphylococcus aureus*
Staphylococcus aureus
Staphylococcus epidermidis
Escherichia coli
Pseudomonas aeruginosa
Klebsiella pneumoniae
Candida albicans

After 7 days of implantation the catheters retained 6-7 mm zones of inhibition against *Staphylococcus aureus*.¹⁴

- Antibacterial activity was retained against *Staphylococcus epidermidis* (10⁶ bacterial concentration) from subcutaneous segments of ARROWgard® antimicrobial surface catheters for at least 120 hours and some up to 520 hours after insertion of the catheters into cardiac surgical patients (both double- and triple-lumen catheters). The zone of inhibition size varied in 7 Fr. triple-lumen catheters from 2.5 to 10 mm at 500 hours.⁴

If the total amount of silver sulfadiazine and chlorhexidine contained in the antimicrobial surface was released from the catheter as a single dose, the blood levels of silver, sulfadiazine, and chlorhexidine that would be found would be less than the blood levels found after clinical usage of these compounds in established safe dosages as administered via mucous membranes and skin.

The potential exposure of patients to the two agents, silver sulfadiazine and chlorhexidine, on the antimicrobial surface is significantly less than that encountered when these compounds are used on burn wounds, on cutaneous wounds, or as mucosal irrigants.

No adverse effects of a toxicologic nature have been associated with the clinical use of this antimicrobial surface in spite of the fact that catheters have been placed in patients sensitive to sulfonamides but who were unaware of their sensitivity.¹¹ However, hypersensitive reactions to chlorhexidine acetate have been reported (May 1996) in Japanese patients.⁹

Indications for Use:

The Arrow® Percutaneous Sheath Introducer permits venous access and catheter introduction to the central circulation.

The ARROWgard® antimicrobial surface is intended to help provide protection against sheath-related infections. The sheath is not intended to be used as a treatment for existing infections, nor is it indicated for long-term use.

The Arrow® SLIC® is a two-piece assembly consisting of an infusion catheter and an obturator. With Arrow® SLIC® obturator removed, the SLIC® permits access to the central venous circulation through an indwelling sheath/hemostasis valve. With SLIC® obturator in place, the SLIC® occludes the hemostasis valve minimizing the risk of air entry and blood loss through the valve.

Contraindications:

The ARROWgärd Blue® antimicrobial sheath is contraindicated for patients with known hypersensitivity to chlorhexidine acetate, silver sulfadiazine, and/or sulfu drugs.

Hypersensitivity reactions are a concern with antimicrobial surfaces, in that they can be very serious and even life-threatening. The ARROWgärd Blue® antimicrobial catheter was introduced worldwide in 1990, and six years elapsed before the first hypersensitivity reaction was reported in Japan in May 1996.⁹

To date (August 2003) the ARROWgärd® reported incident rate has been extremely low, at 1 per 503,081 exposures, and the skin test confirmed rate is even lower, at 1 per 1,446,360 exposures. The vast majority of these episodes (17) have been endemic to individuals of Japanese extraction living in Japan. The literature indicates that individuals of Japanese extraction are known to have had similar hypersensitive reactions following topical chlorhexidine administration.^{13,16,20,21,27,28,32,34} Three (3) incidents have been reported in the UK, two (2) in the USA, and one (1) in New Zealand. **If adverse reactions occur after sheath placement, remove sheath immediately.**

Special Patient Populations:

Since controlled studies of the antimicrobial surface sheath in pregnant women²⁶ and patients with known sulfonamide hypersensitivity such as erythema multiforme and Stevens-Johnson syndrome⁴¹ have not been conducted, benefits of the use of this sheath should be weighed against any possible risk.

Warnings and Precautions:*

1. **Warning:** Chlorhexidine-containing compounds have been used as topical disinfectants since the mid-1970's. An effective antimicrobial agent, chlorhexidine found use in many antiseptic skin creams, mouth rinses, and disinfectants used to prepare the skin for surgical procedures. In addition, chlorhexidine has been incorporated into cosmetic products where it reportedly functions as a cosmetic biocide. In the early 1990's, the FDA cleared three types of medical devices containing chlorhexidine: intravenous catheters, topical antimicrobial skin dressings, and an implanted surgical mesh.¹²

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To date (August 2003) the ARROWgärd® reported incident rate has been extremely low, at 1 per 503,081 exposures, and the skin test confirmed rate is even lower, at 1 per 1,446,360 exposures. The vast majority of these episodes (17) have been endemic to individuals of Japanese extraction living in Japan. The literature indicates that individuals of Japanese extraction are known to have had similar hypersensitive reactions following topical chlorhexidine administration.^{13,16,20,21,27,28,32,34}

Three (3) incidents have been reported in the UK, two (2) in the USA, and one (1) in New Zealand. **If adverse reactions occur after sheath placement, remove sheath immediately.**

- Warning:** Practitioners must be aware of complications associated with percutaneous sheath introduction including vessel wall perforation,³¹ pleural and mediastinal injuries,^{12,22} air embolism,^{7,15,19,24} sheath embolism, thoracic duct laceration,³ bacteremia, septicemia, thrombosis,⁵ inadvertent arterial puncture,⁸ nerve damage, hematoma, hemorrhage,⁴ dysrhythmias, and occlusion.
- Warning:** Do not apply excessive force in removing guide wire, dilator, or sheath. If withdrawal cannot be easily accomplished, a chest x-ray should be obtained and further consultation requested.
- Warning:** The practitioner must be aware of potential air embolism associated with leaving open needles, sheaths, or catheters in venous puncture sites or as a consequence of inadvertent disconnects. To lessen the risk of disconnects, only securely tightened Luer-Lock connections should be used with this device. Follow hospital protocol for all sheath and side port maintenance to guard against air embolism.
- Warning:** Hemostasis valve/side port assembly to Arrow® SLIC® connection and SLIC® to obturator connection must be secured and routinely examined to minimize the risk of disconnection and possible air embolism, hemorrhage, or exsanguination.
- Warning:** Hemostasis valve must be occluded at all times to minimize the risk of air embolism or hemorrhage. If catheter introduction is delayed, or catheter is removed, temporarily cover valve opening with sterile-gloved finger until catheter or obturator is inserted. Use Arrow® SLIC® assembly, included with this product, as dummy catheter with hemostasis valve/side port assembly and sheath. Refer to detailed Arrow® SLIC® instructions on pages 5 and 6. This will ensure that leakage does not occur and inner seal is protected from contamination.²⁴
- Warning:** Passage of guide wire into right heart can cause dysrhythmias, right bundle branch block,¹⁰ and a perforation of the vessel wall, atrial or ventricular.
- Warning:** Practitioners must be aware of the potential for entrapment of guide wire by any implanted device in the circulatory system (ie. vena cava filters, stents). Review patient's history before catheterization procedure to assess for possible implants. Care should be taken regarding the length of spring-wire guide inserted. It is recommended that if patient has a circulatory system implant, catheter procedure be done under direct visualization to minimize the risk of guidewire entrapment.²
- Warning:** Due to the risk of exposure to HIV (Human Immunodeficiency Virus) or other blood borne pathogens, health care workers should routinely use universal blood and body-fluid precautions in the care of all patients.
- Precaution:** Do not suture directly to outside diameter of sheath to minimize the risk of cutting or damaging sheath or impeding sheath flow.
- Precaution:** Indwelling sheaths should be routinely inspected for desired flow rate, security of dressing, correct position and for proper Luer-Lock connection.
- Precaution:** Maintain insertion site with regular meticulous redressing using aseptic technique.

13. **Precaution:** Alcohol and acetone can weaken the structure of polyurethane materials. Check ingredients of prep sprays and swabs for acetone and alcohol content.

Acetone: Do not use acetone on sheath surface. Acetone may be applied to skin but must be allowed to dry completely prior to applying dressing.

Alcohol: Do not use alcohol to soak sheath surface or to restore sheath patency. Care should be taken when instilling drugs containing high concentration of alcohol. Always allow alcohol to dry completely prior to applying dressing.

14. **Precaution:** Some disinfectants used at the sheath insertion site contain solvents, which can attack the sheath material. Assure insertion site is dry before dressing.
15. **Precaution:** Do not inflate balloon of flow-directed catheter prior to insertion through catheter contamination shield to minimize the risk of balloon damage.
16. **Precaution:** Properly dispose of sharps in sharps container in accordance with state/federal OSHA standards for blood borne pathogens and/or institutional policy.

A Suggested Procedure: Use sterile technique.

- Precaution:** Place patient in slight Trendelenburg position as tolerated to reduce the risk of air embolism. If femoral approach is used, place patient in supine position.
- Prep area of anticipated venipuncture.
- Drape puncture site as required.
- Perform skin wheal using desired needle. In kits where provided, the SharpsAway II™ Locking Disposal Cup is used for disposal of needles (15 Ga. - 30 Ga.).
 - Using one-handed technique, firmly push needles into disposal cup holes (refer to Fig. 1).

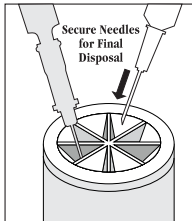


Fig. 1

- Once placed into disposal cup, needles will be automatically secured in place so that they can not be reused.
- Discard entire cup, at completion of procedure, into an approved sharps container.

Precaution: Do not attempt to remove needles that have been placed into cup. These needles are secured in place. Damage may occur to needles if they are forced out of disposal cup.

- Prepare flow-directed catheter according to manufacturer's instructions. Wet balloon with flush solution to facilitate passage through valve of catheter contamination shield. **Precaution:** Do not inflate balloon prior to insertion through catheter contamination shield to minimize the risk of balloon damage.

- Ensure that double TwistLock™ of catheter contamination shield is fully opened (refer to Fig. 2).

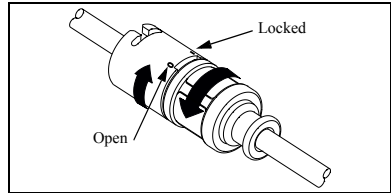


Fig. 2

Insert tip of desired catheter through proximal end of catheter contamination shield. Advance catheter through tubing and hub at other end (refer to Fig. 3).

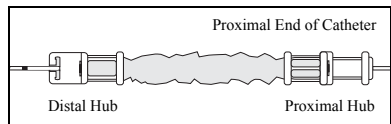


Fig. 3

- Slide entire catheter contamination shield to proximal end of catheter.
- If flow directed catheter is used, inflate and deflate balloon with syringe to ensure integrity. **Precaution:** Do not exceed balloon catheter manufacturer's recommended volume. Place catheter and catheter contamination shield on sterile field awaiting final sheath placement.
- Insert entire length of dilator through hemostasis valve into sheath pressing hub of dilator firmly into hub of hemostasis valve/side port assembly. Place assembly on sterile field awaiting final sheath placement.
- Insert introducer needle with attached Arrow® Raulerson Syringe into vein and aspirate. (If larger introducer needle is used, vessel may be pre-located with 22 Ga. locator needle and syringe). Remove locator needle.

Alternate technique:

Catheter/needle may be used in the standard manner as alternative to introducer needle. If catheter/needle is used, Arrow® Raulerson Syringe will function as a standard syringe, but will not pass spring-wire guide. If no free flow of venous blood is observed after needle is removed, attach syringe to catheter and aspirate until good venous blood flow is established. **Precaution:** The color of blood aspirated is not always a reliable indicator of venous access.¹⁷ Do not reinsert needle into introducer catheter.

- Because of the potential for inadvertent arterial placement, one of the following techniques should be utilized to verify venous access. Insert fluid primed blunt tip transduction probe into rear of plunger and through valves of Arrow® Raulerson Syringe. Observe for central venous placement via a wave form obtained by a calibrated pressure transducer. Remove transduction probe (refer to Fig. 4).

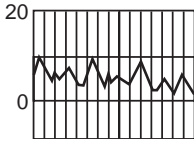


Fig. 4

Alternate technique:

If hemodynamic monitoring equipment is not available to permit transducing a central venous wave form, check for pulsatile flow by either using the transduction probe to open syringe valving system or by disconnecting syringe from needle. Pulsatile flow is usually an indicator of inadvertent arterial puncture.

- Using the two-piece Arrow Advancer™, advance spring-wire guide through syringe into vein. **Warning: Aspiration with spring-wire guide in place will cause introduction of air into syringe. Precaution: To minimize the risk of leakage of blood from syringe cap do not reinfuse blood with spring-wire guide in place.**

Two-Piece Arrow Advancer™ Instructions:

- Using your thumb, straighten the “J” by retracting spring-wire guide into the Arrow Advancer™ (refer to Figs. 5, 6).

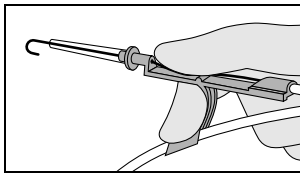


Fig. 5

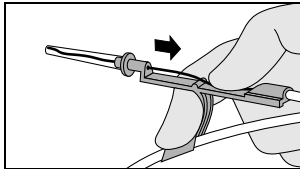


Fig. 6

When tip is straightened, spring-wire guide is ready for insertion. Centimeter marks on guide wire are referenced from “J” end. One band indicates 10 cm, two bands 20 cm, and three bands 30 cm.

Introducing the Spring-Wire Guide:

- Place tip of Arrow Advancer™ – with “J” retracted – into the hole in rear of Arrow® Raulerson Syringe plunger (refer to Fig. 7).

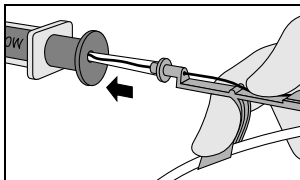


Fig. 7

- Advance spring-wire guide into syringe approximately 10 cm until it passes through syringe valves (refer to Fig. 8).

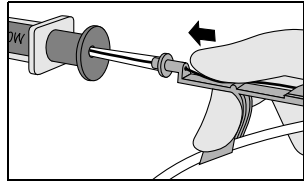


Fig. 8

- Raise your thumb and pull Arrow Advancer™ approximately 4-8 cm away from syringe. Lower thumb onto Arrow Advancer™ and while maintaining a firm grip on spring-wire guide, push assembly into syringe barrel to further advance spring-wire guide. Continue until spring-wire guide reaches desired depth (refer to Fig. 9).

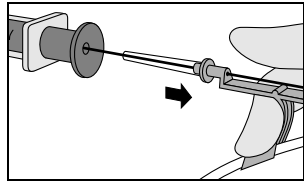


Fig. 9

Alternate Technique:

If a simple straightening tube is preferred, the straightening tube portion of the Arrow Advancer™ can be disconnected from the unit and used separately.

Separate the Arrow Advancer™ tip or straightening tube from blue Arrow Advancer™ unit. If “J” tip portion of spring-wire guide is used, prepare for insertion by sliding the plastic tube over “J” to straighten. The spring-wire guide should then be advanced in routine fashion to desired depth.

- Advance guide wire until triple band mark reaches rear of syringe plunger. Advancement of “J” tip may require a gentle rotating motion. **Warning: Do not cut spring-wire guide to alter length. Do not withdraw spring-wire guide against needle level to minimize the risk of possible severing or damaging of spring-wire guide.**
- Hold spring-wire guide in place and remove introducer needle and Arrow® Raulerson Syringe (or catheter). **Precaution: Maintain firm grip on spring-wire guide at all times.** Use centimeter markings on spring-wire guide to adjust indwelling length according to desired depth of indwelling sheath placement.
- Enlarge cutaneous puncture site with cutting edge of scalpel positioned away from the spring-wire guide. **Precaution: Do not cut guide wire. Retract scalpel in the protected position (refer to Fig. 10).**

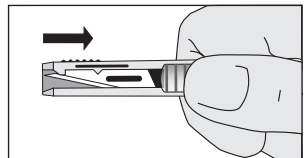


Fig. 10

16. Thread tapered tip of dilator/sheath/valve assembly over spring-wire guide. Grasping near skin, advance assembly with slight twisting motion to a depth sufficient to enter vessel. Dilator may be partially withdrawn to facilitate advancement of sheath through tortuous vessel. **Precaution: Do not withdraw dilator until sheath is well within vessel to minimize the risk of damage to sheath tip.**
17. Advance sheath/valve assembly off dilator into vessel, again grasping near skin and using slight twisting motion.
18. To check for proper sheath placement within vessel, remove side port end cap and attach syringe for aspiration. Hold sheath/valve assembly in place and withdraw spring-wire guide and dilator sufficiently to allow venous blood flow to be aspirated into side port. **Precaution: Maintain firm grip on spring-wire guide at all times.**
19. Holding sheath/valve assembly in place, remove guide wire and dilator as a unit. Place sterile-gloved finger over hemostasis valve. **Warning: To minimize the risk of possible vessel wall perforation do not leave dilator in place as an indwelling catheter. Warning: Although incidence of spring-wire guide failure is extremely low, practitioner should be aware of the potential for breakage if undue force is applied to the wire.** Flush and connect side port to appropriate line as necessary.
20. Feed catheter through sheath/valve assembly into vessel. Advance catheter to desired position. **Warning: Hemostasis valve must be occluded at all times to minimize the risk of air embolism or hemorrhage. If catheter introduction is delayed, temporarily cover valve opening with sterile-gloved finger until SLIC® assembly is inserted. Use Arrow® SLIC® assembly, included with this product, as dummy catheter with hemostasis valve/side port assembly and sheath. Refer to detailed Arrow® SLIC® instructions on page 5 and 6. This will ensure that leakage does not occur and inner seal is protected from contamination.**²⁴
21. Hold catheter in place and reposition catheter contamination shield so that distal hub is approximately five inches (12.7 cm) from hemostasis valve/side port assembly (refer to Fig. 11).

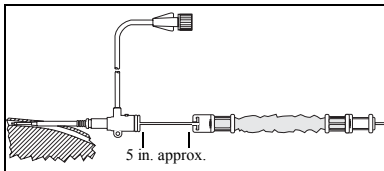


Fig. 11

22. Hold proximal hub of catheter contamination shield in place. Disengage distal hub from inner feed tube by pulling forward. Advance distal hub forward toward hemostasis valve/side port assembly. Hold assembly in place (refer to Fig. 12).

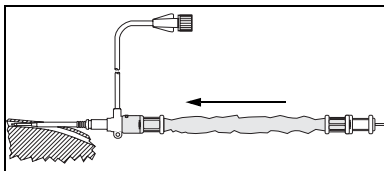


Fig. 12

23. Press distal hub of catheter contamination shield over assembly cap. Twist to lock (refer to Fig. 13).

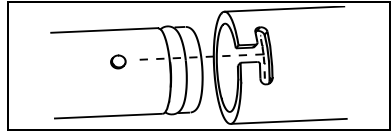


Fig. 13

- Orient slot in hub with locking pin on assembly cap.
- Slide hub forward over cap and twist.

24. While maintaining catheter position, twist upper half of distal hub in clockwise direction to lock catheter in place. Reposition proximal end of catheter shield as desired. Twist upper and lower halves in opposite directions to lock in place. Test adapter by gently tugging on catheter to ensure a secure grip on catheter (refer to Fig. 14). **Precaution: Do not reposition proximal hub once locked in final position.**

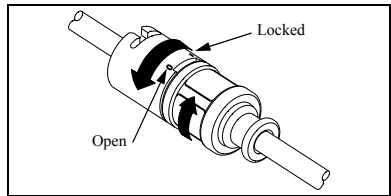


Fig. 14

25. Use suture tab to secure sheath and/or anchor with a purse string suture around sheath suture ring. **Precaution: Do not suture directly to outside diameter of sheath to minimize the risk of cutting or damaging the sheath or impeding sheath flow.**
26. Dress puncture site per hospital protocol. **Precaution: Maintain insertion site with regular, meticulous redressing using aseptic technique.**
27. Record insertion procedure on patient's chart.

Single Lumen Infusion Catheter (SLIC®) A Suggested Procedure: Use sterile technique.

1. **Precaution: Place patient in slight Trendelenburg position as tolerated to reduce the risk of air embolism. If femoral approach is used, place patient in supine position.**
2. **Warning: Hemostasis valve must be occluded at all times to minimize the risk of air embolism or hemorrhage. If catheter is removed from sheath or catheter insertion is delayed, temporarily cover valve opening with sterile-gloved finger followed by insertion of Arrow® SLIC® assembly. Twist to lock (refer to Fig. 15).**

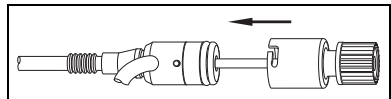


Fig. 15

- Orient slot in hub with locking pin on assembly cap.
- Slide hub forward over cap and twist.

Precaution: When Arrow® SLIC® assembly is inserted after catheter removal, use an appropriate antiseptic to prep hemostasis valve housing prior to inserting the SLIC®. Include exposed portion of valve on top of housing.

The Arrow® SLIC®, with obturator in place, occludes the hemostasis valve minimizing the risk of air entry or blood loss.

Warning: Connection between Arrow® SLIC® obturator and SLIC® must be tightened securely and routinely examined to minimize the risk of disconnection and possible air embolism, hemorrhage or exsanguination.

- To use the Arrow® SLIC® for intravenous infusion, remove blue-capped Arrow® SLIC® obturator by twisting counterclockwise. Hold infusion port to maintain positive lock to hemostasis valve housing. Pull SLIC® obturator from infusion catheter (refer to Fig. 16). Immediately attach desired line to Luer-Lock hub. **Warning:** Exposure of the central vein to atmospheric pressure may result in entry of air into the central venous system. Inspect the SLIC® obturator to ensure that entire length has been withdrawn. Document SLIC® obturator withdrawal and start of infusion.

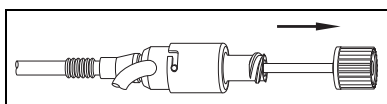


Fig. 16

- If infusion through the Arrow® SLIC® is discontinued, the hub should be capped with a Luer-Lock injection cap and handled per hospital flushing protocol, or the SLIC® should be withdrawn and replaced with a sterile Arrow® obturator, sold separately, to ensure that leakage does not occur and inner seal is protected from contamination. **Warning:** Cover the lumen during any manipulation to minimize the risk of blood loss or introduction of air into the sheath.

Catheter Removal Procedure:

- Precaution:** Place patient in a supine position.
- Remove dressing, if applicable. **Precaution:** To minimize the risk of cutting the sheath, do not use scissors to remove dressing.
- Twist distal hub of catheter contamination shield to allow removal from locking pin on hemostasis valve/side port assembly. Withdraw catheter from sheath. **Warning:** Hemostasis valve must be occluded at all times to minimize the risk of air embolism or hemorrhage. Temporarily cover valve opening with sterile-gloved finger until catheter or obturator is inserted.

Sheath Removal Procedure:

- Precaution:** Place patient in a supine position.
- Remove dressing, if applicable. **Precaution:** To minimize the risk of cutting the sheath, do not use scissors to remove dressing.
- If applicable, remove sutures from sheath. **Precaution:** Be careful not to cut the sheath.
- Withdraw device from sheath. Cover hemostasis valve with sterile-gloved finger. **Warning:** Hemostasis valve must be occluded at all times to minimize the risk of air embolism or hemorrhage.
- Warning:** Exposure of the central vein to atmospheric pressure may result in entry of air into the central venous system. Remove sheath slowly, pulling it parallel to skin. As sheath exits site, apply pressure with a dressing impermeable

to air, e.g. Vaseline® gauze. Because the residual sheath track remains an air entry point until completely sealed, occlusive dressing should remain in place for at least 24-72 hours dependent upon amount of time sheath was indwelling.^{18,29,30,33}

- Upon removal of sheath, inspect it to make sure entire length has been withdrawn.
- Document removal procedure.

References:

- Albertson TE, Fisher CJ, Vera Z. Accidental mediastinal entry via left internal jugular vein cannulation. *Intensive Care Med.* 1985;11:154-157.
- Andrews RT, Bova DA, Venbrux AC. How much guidewire is too much? Direct measurement of the distance from subclavian and internal jugular vein access sites to the superior vena cava-atrial junction during central venous catheter placement. *Crit Care Med.* Jan.
- Arditis J, Giala M, Anagnostidou A. Accidental puncture of the right lymphatic duct during pulmonary artery catheterization. *Acta Anaesthesiol Scand.* 1988;32:67-68.
- Bach A, Schmidt H, Bottinger B, et al. Retention of antibacterial activity and bacterial colonization of antiseptic-bonded central venous catheters. *J Antimicrob Chem.* 1996;37:315-322.
- Benumof JL. Thrombosis after pulmonary-artery catheterization via the internal jugular vein. *NEJM.* 1982;306:1487. Letter.
- Benya RV. Fibrin sheath formation surrounding a pulmonary artery catheter sheath: eversion of the sleeve during catheter removal. *Crit Care Med.* 1990;18:345. Letter.
- Bristow A, Batjer H, Chow V, Rosenstein J. Air embolism via a pulmonary artery catheter introducer. *Anesthesiology.* 1985;63:340-341. Letter.
- Brzowski BK, Mills JL, Beckett WC. Iatrogenic subclavian artery pseudoaneurysms: case reports. *J Trauma.* 1990;30:616-618.
- Data on file, Arrow International, Inc.
- Eissa NT, Kvetan V. Guide wire as a cause of complete heart block in patients with preexisting left bundle branch block. *Anesthesiology.* 1990;73:772-774.
- Farber T. ARROWgard™ antiseptic surface –toxicology review. Monograph. Published by Arrow International, Inc. April 1992.
- FDA Public Health Notice. Potential hypersensitivity reactions to chlorhexidine-impregnated medical devices. Food and Drug Administration Web site. Available at: <http://www.fda.gov/cdrh/chlorhex.html>. Accessed October 26, 1999.
- Fukui A, Ohsumi A, Takaori M. A case of anaphylactic shock induced by chlorhexidine glucuronate. *J Japan Society Clin Anesthesia.* 1989;9:356-360.
- Greenfeld JJ, Sampath L, Popliskis SJ, Brunnett SR, Stylianos S, Modak S. Decreased bacterial adherence and biofilm formation on chlorhexidine and silver sulfadiazine-impregnated central venous catheters implanted in swine. *Crit Care Med.* 1995;23:894-900.
- Hartung EJ, Ender J, Sgourpoulou S, Bierl R, Engelhardt W, Engemann R. Severe air embolism caused by a pulmonary artery introducer sheath. *Anesthesiology.* 1994;80:1402-1403. Letter.

16. Harukuni I, Ishizawa Y, Nishikawa T, Takeshima R, Dohi S, Naito H. Anaphylactic shock with ventricular fibrillation induced by chlorhexidine. *Japanese J Anesthesiology*. 1992;41:455-459.
 17. Jobes DR, Schwartz AJ, Greenhow DE, Stephenson LW, Ellison N. Safer jugular vein cannulation: recognition of arterial punctures and preferential use of the external jugular route. *Anesthesiology*. 1983;59:353-355.
 18. Kashuk JL, Penn I. Air embolism after central venous catheterization. *Surg Gynecol Obstet*. September 1984;159:249-252.
 19. Kondo K, O'Reilly LP, Chiota J. Air embolism associated with an introducer for pulmonary arterial catheters. *Anesth Analg*. 1984;63:871-872.
 20. Kubo H, Akiyama Y, Honda K, Nakajo N. Anaphylaxis following oral irrigation with chlorhexidine gluconate. *J Japanese Dental Society Anesthesiology*. 1985;13:659-663.
 21. Layton GT, Stanworth DR, Amos HE. The incidence of IgE and IgG antibodies to chlorhexidine. *Clin Experimental Allergy*. 1989;19:307-314.
 22. Macksood MJ, Setter M. Hydrothorax and hydromediastinum after use of an indwelling percutaneous catheter introducer. *Crit Care Med*. 1983;11:957-958.
 23. Maki DG, Wheeler SJ, Stolz SM, Mermel LA. Prevention of central venous catheter-related bloodstream infection by use of an antiseptic-impregnated catheter. *Ann Int Med*. August 15, 1997;127:257-266.
 24. Mihm FG, Rosenthal MH. Pulmonary artery catheterization. In: Benumof JL, ed. *Clinical Procedures in Anesthesia and Intensive Care*. Philadelphia, PA: JB Lippincott; 1992. p. 419.
 25. Modak SM, Sampath L. Development and evaluation of a new polyurethane central venous antiseptic catheter: reducing central venous catheter infections. *Infections in Medicine*. June 1992;23:29.
 26. Modak SM. (Written communication, June 1991).
 27. Okano M, Nomura M, Hata S, et al. Anaphylactic symptoms due to chlorhexidine gluconate. *Arch Dermatol*. 1989;125:50-52.
 28. Okano M, Nomura M, Okada N, Sato K, Tashiro M. Four cases presenting anaphylactic reactions due to topical application of Hibitane®. *Skin Research*. 1983;25:587-592.
 29. Paskin DL, Hoffman WS, Tuddenham WJ. A new complication of subclavian vein catheterization. *Ann Surg*. March 1974;179:266-268.
 30. Phifer TJ, Bridges M, Conrad SA. The residual central venous catheter track - an occult source of lethal air embolism: case report. *J Trauma*. 1991;31:1558-1560.
 31. Roy RC. Possible hazards from catheter sheath introducers. *Crit Care Med*. 1984;12:616. Letter.
 32. Takeda K, Inoue K, Matsuya T, et al. An allergic shock possibly induced by the chlorhexidine: report of a case. *J Osaka Univ Dent Soc*. 1985;30:221-225.
 33. Thielen JB, Nyquist J. Subclavian catheter removal. *J Intravenous Nurs*. March/April 1991;14:114-118.
 34. Tsuneto S, Watanabe S, Koyama K, Nakayama K, Saito H, Saito K. Anaphylaxis shock induced by chlorhexidine mixed in the vial of lidocaine. *J Japan Society Clin Anesthesia*. 1987;7:272-277.
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