

Pulmonary Artery Catheter Insertion (Assisting)

Site Applicability

PHC Critical Care Areas.

Practice Level

Advanced Competency:

- Only Registered Nurses who have completed a recognized post-graduate critical care course, or equivalent education and experience, can assist with pulmonary artery (PA) catheter insertion

Requirements

Safety considerations

1. Never flush the PA catheter when the balloon is wedged in the pulmonary artery
2. Never leave the PA catheter balloon inflated for more than 10 seconds
3. Do not fast flush the catheter for longer than 2 seconds (to avoid pulmonary artery injury with prolonged flushing)
4. Never infuse IV fluids via the distal lumen
5. Never infuse blood products or albumin through the PA catheter
6. Never attach a VAMP system to the distal PA port

Critical care nurses are **not** responsible for:

1. Inserting PA catheters
2. Adjusting PA catheter position
3. Removing PA catheters (*Note:* PA catheter removal is performed by RNs with advanced skills in CSICU only.)

Need to Know

PA catheters are used to assess indicators of hemodynamic status including right- and left-sided intracardiac pressures and cardiac output (CO). Information obtained from PA catheters can be used to guide therapies including fluids, diuretics, and the titration of vasoactive and inotropic infusions.

Equipment and Supplies

- PA catheter
- Percutaneous sheath introducer kit
- Infusion pump (e.g. Alaris infusion pump)

- Infusion pump tubing (e.g. Alaris IV tubing) primed with 250 mL NS (to run TKVO on side-arm of percutaneous sheath introducer)
- Protective contamination sleeve (e.g. cath-gard catheter contamination shield)
- Transducer cables
- CO Philips module
- Swan-Ganz bridge or three-way stopcocks
- Pressure transducer tubing
- Flush solution (NS 500 mL)
- Pressure bag
- Transducer holder and IV pole
- Personal protective equipment (caps, fluid-shield masks, sterile gowns, gloves, drapes)
- Sterile NS flush syringes
- Antiseptic solution
- Sterile dressing supplies
- Sterile patient drapes
- Red dead-ender cap
- Leveling device

To set up PA line for use with the thermodilution technique:

- Cardiac output cable with thermistor/injectate sensor
- Cardiac output tubing set
- Injectate solution (D5W 500 mL)

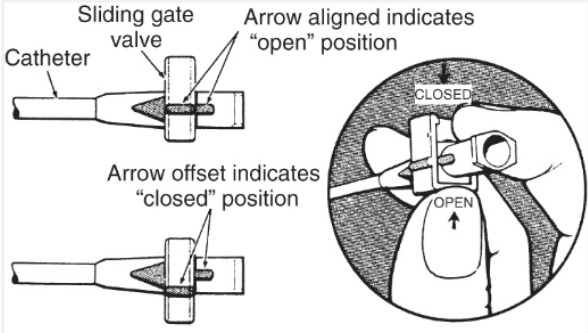
Additional equipment as needed may include the following:

- Fluoroscope and protective leads (as determined by physician)
- Emergency equipment and temporary pacing equipment
- Ultrasound machine (as determined by physician)

Note: (CSICU only) See [Appendix B](#) for calibration instructions when using the continuous oxymetric Swan-Ganz PA catheter

Procedure

Procedure	Rationale
1. Prepare and prime pressure transducer set-up with NS 500mL IV solution. Tighten all connections	Three-way stopstocks or, alternatively, a Swan-Ganz bridge (see Appendix A) may be used to manage PA lumens. Flush the entire transducer system including pressure tubing, transducer, and three-way stopcocks (or Swan-Ganz bridge) with NS solution to eliminate air.
2. Inflate pressure bag to 300 mmHg	
3. Ensure TKVO infusion available for the side arm of the percutaneous sheath introducer if not already in use.	Maintains patency of the sheath introducer port
4. Fluoroscopy may be used for this procedure (Clarify with MD pre-procedure if fluoroscopy is desired). Pre-arrange with x-ray department for technician and machine to be present during procedure.	
5. Establish a baseline physical assessment	See B-00-13-10017 – Physical Assessment: Critical Care
6. Ensure cardiac rhythm is monitored continuously throughout procedure	The PA insertion procedure can cause arrhythmias. Ensure advanced cardiac life support equipment is readily available
7. Provide patient teaching	Reduces patient's discomfort
8. Assess patient need for pre-procedure analgesic and/or sedation and discuss with MD	
9. If fluoroscopy is being used, don protective leads.	Protective leads are required for all personnel within 6 to 8 feet of the patient during active fluoroscopy to protect from radiation
10. Ensure balloon tested and contamination sleeve used before insertion. Assist MD to connect PA line lumens to transducer tubing and flush each port. Connect the pressure cables. Level and zero transducer.	Once PA line insertion begins, continuously run an ECG and PA distal waveform.
11. If the PA catheter is being inserted without fluoroscopy, communicate waveform interpretations with physician to guide positioning and placement. Record opening Right Atrium and Right Ventricle pressures for MD. Inflate and deflate balloon as per MD direction.	Only the MD is to handle the catheter during insertion (e.g. advancing PA catheter, repositioning PA catheter).

12. Print recording strip of PCWP measurement	The MD inserting the PA catheter must perform the initial pulmonary wedge. If PEEP is being used, and the PEEP is more than 10 cm H ₂ O, adjust the mean measurement point for evaluating PCWP.
13. Once PA position is obtained and confirmed by waveform analysis or fluoroscopy, ensure balloon is deflated and the gate valve remains open with syringe attached and plunger closed.  Gate Valve Operation <small>Pulmonary artery catheter gate valve. Top left, Gate valve in the open position. Bottom left, Gate valve in the closed position. (Courtesy of Edwards Lifesciences, Irvine, CA.)</small>	During insertion monitor for acute pneumothorax (signs and symptoms may include respiratory distress, tracheal deviation, and unilateral diminished breath sounds)
14. Arrange for a chest x-ray following the procedure as per MD order	A portable chest x-ray is usually obtained following the procedure to confirm correct PA catheter placement unless if PA catheter was inserted under fluoroscopy.

Assessment and Interventions

Initial Assessment	Interventions
<p>Immediately following insertion of a PA line, assess and document:</p> <ul style="list-style-type: none"> VS (BP, HR, RR, SpO₂ or SaO₂, Temp) Hemodynamic monitoring parameters (CVP, PAP, PCWP, CO) Heart sounds (clarity) Breath sounds and respiratory qualities Cardiac rhythm Characteristics of the percutaneous sheath introducer site: <ul style="list-style-type: none"> - Observe for signs of bleeding (blood at site, swelling or palpable hematoma, bruising) and infection 	<p>Notify the physician immediately if assessment findings reveal:</p> <ul style="list-style-type: none"> Spontaneous wedge waveform Arrhythmias Change in mental or respiratory status Distant (muffled) heart sounds Absent or diminished breath sounds unilaterally (if changed from baseline assessment) Decreasing QRS amplitude Increasing air-required to fill PCWP balloon Displacement of the PA catheter



<p>(purulent drainage, redness)</p> <ul style="list-style-type: none"> - Apply clear occlusive dressing to insertion site (avoid taping over protective plastic guard) <ul style="list-style-type: none"> • Characteristics of the PA line: <ul style="list-style-type: none"> - Measure the internal PA line placement using the black markings on the PA line - Ensure the PA line is well secured - Ensure PA balloon port is open 	<p>Complete initial cardiac output calculations.</p> <p>For thermodilution, ensure correct computation constant set in monitor according to manufacturer guidelines (see Appendix C).</p> <p>In CICU: Initial cardiac output should be calculated by both FICK principle & thermodilution to determine preferred method with MD.</p> <p>Document PA position and record the volume of air used to inflate the balloon on initial wedge.</p> <p>Daily chest x-ray should be performed while PA catheter remains in situ.</p>
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Documentation

Procedure:

1. **Pulmonary Artery Catheter dynamic group:** Date, time, patient education, insertion site, size of introducer sheath, type and size of PA catheter placed, equipment used to determine PA positioning and placement, physician performing the procedure, and any unexpected outcomes and emergency interventions that were required during procedure.

Measure and record the PA placement using the centimeter markings on the PA line; internal measurements are taken at the hub of the sheath introducer. Record the amount of PA balloon volume required to wedge. Document the computation constant as needed.

2. **Critical Care Quick View:** Pre- and post- procedure VS; hemodynamic parameters including: PAS, PAD, PAM, PCWP, CO, CI, SVR, PVR; mixed venous and arterial blood gas (if drawn)
3. **ECG Strip Flowsheet** (Form no. PHC-IC004): Pre- and post- procedure cardiac rhythm strips, PCWP waveform recording
4. **MAR:** Medications administered during procedure

Post-procedure:

1. **Critical Care Quick View:** hemodynamic parameters including mixed venous and arterial blood gas sample (if drawn) (*Note:* see [B-00-13-10017](#) – Physical Assessment: Critical Care for expected VS frequencies and ongoing hemodynamic monitoring)



2. **Pulmonary Artery Catheter dynamic group:** document status of lumens, status of waveforms, position of PA line, and status of site and dressing q4h
3. **Pulmonary Artery Catheter dynamic group:** Removal of PA catheter, noting provider who performed procedure and any unexpected outcomes and emergency interventions that were required

Patient and Family Education

- Explain the purpose of the PA catheter and the insertion procedure
- Review activity allowed

Related Documents

1. [B-00-12-40045](#) – CVC: Non-Tunneled Central Venous Catheter (NT-CVC) - Basic Care and Maintenance (Adult)
2. [B-00-13-10017](#) – Physical Assessment: Critical Care Areas
3. [B-00-13-10182](#) – Pulmonary Wedge Pressure, Minimizing Risk When Obtaining
4. [B-00-13-10035](#) – Pulmonary Artery Catheter: removal, procedure

References

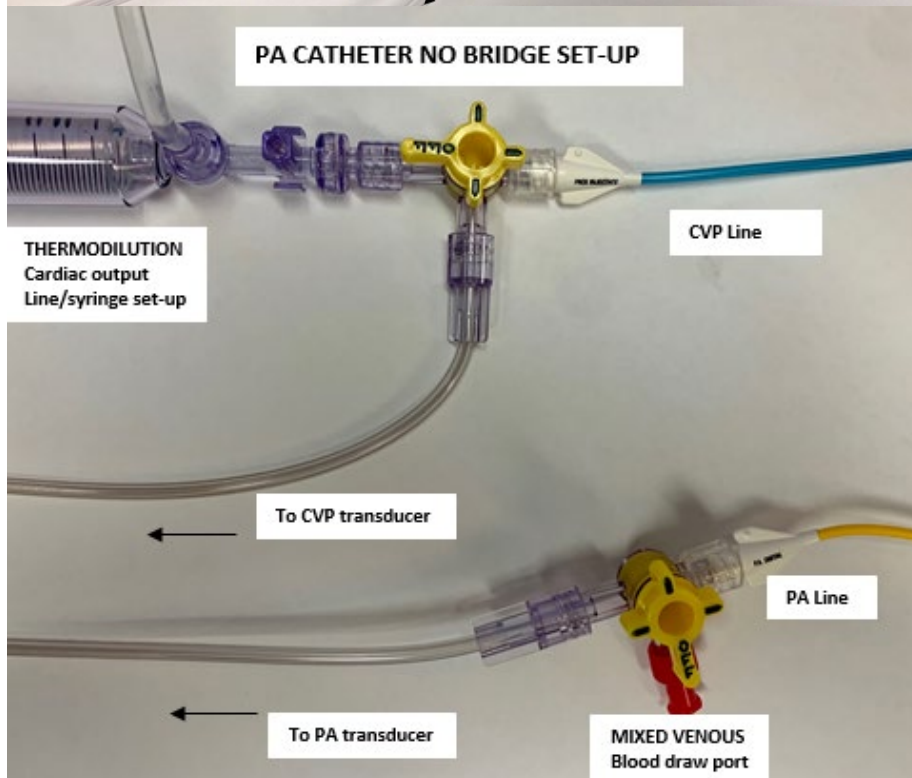
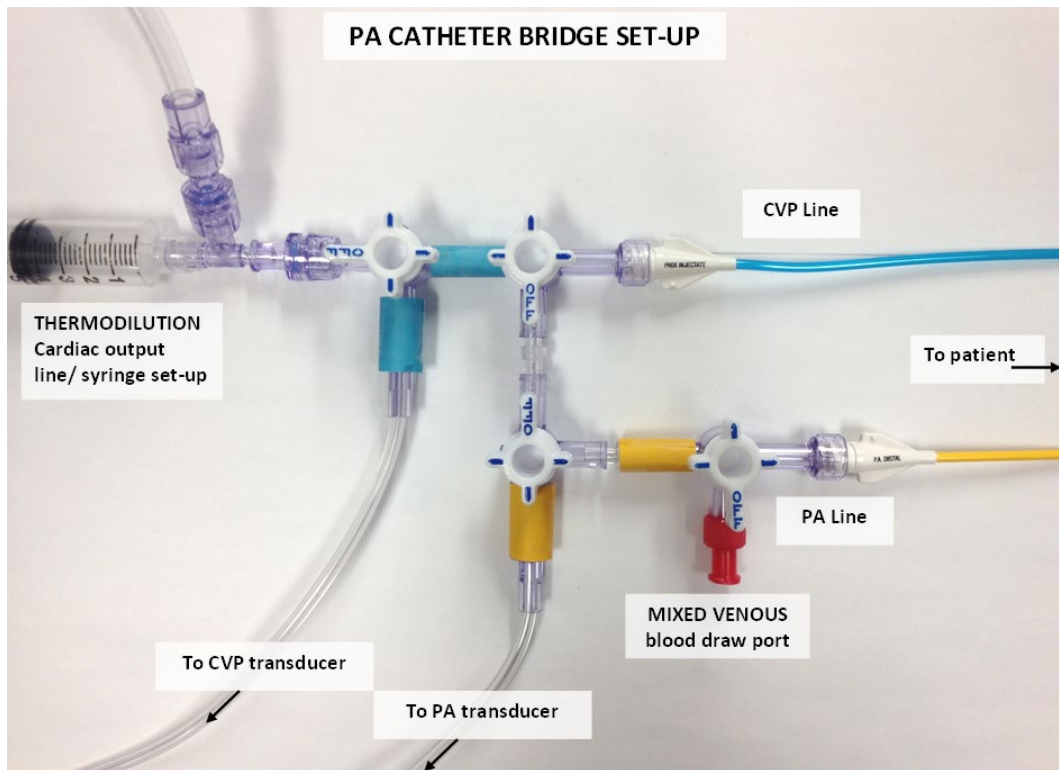
1. Fleck, D. (2011) Pulmonary artery catheter insertion (perform). In D. Wiegand (Ed). AACN procedure manual for critical care (6th ed) pp. 617-625. St. Louis, Missouri. Saunders
2. Pulmonary Artery Catheter Insertion (Assisting) and Monitoring. Elsevier Clinical Skills (2021). St Louis, Missouri. Elsevier. Retrieved February 1, 2022 from www.elsevier.com
3. Preuss, T. and Wiegand, D. (2011). Central venous/right arterial pressure monitoring. In D. Weigand (Ed) procedure manual for critical care (6th Ed) pp. 603-608. St. Louis, Missouri. Saunders
4. Weinhouse, G. (2021). Pulmonary artery catheters: Insertion technique in adults. In D.S. Baslow (Ed) UpToDate, Waltham, MA. UpToDate.

Appendices

- [Appendix A: PA Catheter Bridge Set-Up](#)
- [Appendix B: SvO₂ Calibration](#)
- [Appendix C: Computation constants](#)



Appendix A: PA Catheter Bridge Set-Up





Appendix B: SvO₂ Calibration



Edwards Vigilance Monitor Venous Oxygen Saturation

Abbreviated Instructions for Use

To Perform *In Vitro* Calibration:

1. Connect catheter to optical module. Connect optical module to Vigilance Monitor.
2. Press **SvO₂** on blue touch bar.
3. Select **IN VITRO CALIBRATION** on the touch bar.
4. Use the **CURSOR** key to select HGB (hemoglobin) **OR** Hct (hematocrit).
 - a. Use default value or enter lab value using touch bar.
5. Press the **CAL** key.
6. Upon completion of a successful calibration, the monitor will display the following message: "In Vitro Calibration OK. Insert Catheter then press Start SvO₂".
7. Remove catheter from tray.
8. Flush catheter.
 - a. Never flush lumens before In Vitro Calibration.
 - b. If using a Swan-Ganz catheter, check balloon.
9. Insert catheter into appropriate position as indicated on the product's "Directions for Use" sheet.
10. Press **START SvO₂**.

To Perform *In Vivo* Calibration:

1. Press **SvO₂** on blue touch bar.
2. Confirm catheter position and SQI before performing – Press **IN VIVO CALIBRATION**.
3. Press **DRAW**, after checking for SQI of 1 or 2.
4. Slowly draw waste sample and discard. Slowly draw lab sample and send for analysis by co-oximeter.
5. Use the **CURSOR** to select value, enter lab results using touch bar.
6. Press **CAL**.

To Transport:

1. After reconnecting patient cable and optics module to the Vigilance Monitor, **WAIT 20 SECONDS**, press **SvO₂** on touch bar.
2. Press **TRANSPORT**.
3. Press **RECALL**.
 - a. Calibration data must be less than 24 hours old.
 - b. Make sure time and date match if using different monitors.



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SQL for Venous Saturation Monitoring



LEVEL	SIGNAL	DESCRIPTION
1	Normal	All aspects of the signal are optimal
2	Intermediate	Indicates a moderately compromised signal
3	Poor	Indicates poor signal quality
4	Unacceptable	Indicates severe problem with one or more aspects of signal quality

Signal quality may be compromised by:

- Pulsatility.
- Signal intensity (e.g., kinking of catheter, blood clot, hemodilution).
- Intermittent wall contact by the catheter.

Signal quality may be improved by:

- Try to aspirate distal lumen; if able to aspirate, flush lumen with extreme caution.
- Check catheter for kinking and recalibrate; replace catheter if required and recalibrate.
- Reposition catheter and if SQL > 2, recalibrate monitor by performing *in vivo* calibration.
- Attempt to distance electrocautery equipment and cables from the Vigilance monitor.
- Plug the power cords into separate AC circuits if possible.
- Update entered hemoglobin and hematocrit values when there is a physiologic change of 6% or greater in hematocrit or of 1.8 g/dL (1.1 mmol/L) or greater in hemoglobin.



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Edwards Lifesciences

Edwards Lifesciences LLC · Irvine, CA 92614 USA · 949.250.2500 · www.edwards.com
Edwards Lifesciences (Canada) Inc. · Mississauga, Ontario · Canada · 905.566.4220
Edwards Lifesciences S.A. · Ch. du Glapin 6 · Switzerland · 41.21.823.4300
Edwards Lifesciences Japan · Chiyoda-ku, Tokyo 102-0085 · Japan · 81.3.5213.5700



Edwards Vigileo Monitor ~ PreSep Central Venous Catheter for ScvO₂ Monitoring

Name:

Unit:

Date:

Critical Elements	Met	Not Met
<p>1. <u>Set-up for Vigileo</u></p> <ul style="list-style-type: none"> Connects the optical module to the oximetry (red to red) connector on the back of the Vigileo monitor. Allows 20 minutes for the optical module to warm up. Opens the PreSep central venous catheter lid exposing only the optics connection (or entire tray if physician is inserting at that time). Removes optics connection being careful not to contaminate tray contents. Connects PreSep central venous catheter to optical module matching "TOP" on both optical module and optics connection. Performs an In-Vitro calibration before inserting the catheter by: <ul style="list-style-type: none"> Rotates the navigation knob to highlight the Oximetry Frame and presses to display the Oximetry Menu. Rotates the knob to select "Parameter" and then presses the knob. Rotates the knob and highlight the parameter to be used for oximetry (ScvO₂ - when using the PreSep central venous catheter or SvO₂ – Edwards PA CCO / Oximetric catheter). Rotates the navigation knob to select "HGB" (hemoglobin) or "HCT" (hematocrit), then enters the lab if available or otherwise uses the default values. Selects "Calibrate". (Message seen: "In vitro calibration in progress. Ready in 20 seconds.) When the countdown reaches 0 seconds, message seen: "In vitro calibration OK. Insert catheter then select Start." 		
<p>2. <u>Performing an "In-Vivo" calibration</u> (May be done as an alternative to "In-Vitro" calibration. Must be done every 24 hours thereafter.)</p> <ul style="list-style-type: none"> Rotates the navigation knob to highlight "In vivo Calibration". Selects "Continue" unless a "Wall Artifact or Sedge Detected or Unstable Signal" message appears. Attempts to troubleshoot per manual. Presses the navigation knob and then: <ul style="list-style-type: none"> Draws waste sample first – slowly from the distal lumen. Draws lab blood gas sample slowly (2 ml over 30 seconds). Labels sample central venous blood gas sample (if from PreSep catheter) or mixed venous blood gas sample if from distal lumen of Edwards COO/SVO₂ catheter). Sends sample to Blood Gas Lab. Upon receipt of lab values from drawn sample, uses the navigation knob to enter the oximetry value and either HGB or HCT value. After values are entered, rotates navigation knob to select "Calibrate". (At end of 25 second countdown, the Calibration Menu is removed from the screen and the Oximetry Menu is displayed.) 		
<p>3. <u>Vigileo Oximetry Monitor Recall Optical Module Data</u></p> <ul style="list-style-type: none"> Discusses the importance of not disconnecting the optical module from the connector or data will be lost. When transporting patients, knows to disconnect to optical module cable from the back of the Vigileo monitor. If optical module is being connected to another Vigileo monitor, makes sure that previous patient data is cleared from the monitor. After transfer back to unit, reconnects optical module cable to the Vigileo monitor. Rotates the navigation knob to highlight the "Oximetry Frame". Presses the knob. Under the Oximetry Frame, selects "Recall OM Data." The calibration data in the optical module will be displayed. If optical module data is less than 24 hours old, confirms instructions and a Yes/No confirmation is displayed. Selects "Yes" to start oximetry monitoring using the recalled calibration information OR selects "No" and performs an in vivo calibration. 		

☐ Passed Competency ☐ Needs to Repeat Competency Validated by: _____



Appendix C: Computation Constants

(current model in SPH ICU/CICU is 131F7, CSICU 131F7 or 774F75)

CO-Set+ Closed Injectate Delivery System

Swan-Ganz catheter model	Injectate Temperature			
	Cold		Room Temperature	
	10cc (6-12°C)	5cc (8-16°C)	10cc (18-25°C)	5cc (18-25°C)
139F75, 177F75N, 744F75, 774F75	0.574	0.287	0.595	0.298
746F8, 777F8	0.559	0.263	0.602	0.295
780F75M, 782F75M	0.574	0.287	0.595	0.298
631F55N	–	0.284	–	0.306
TS105F5	0.552	0.265	0.589	0.289
132F5	–	0.285	–	0.307
096F6	0.558	0.277	0.607	0.301
131F7	0.561	0.259	0.608	0.301
141F7	0.561	0.259	0.608	0.301
151F7	0.561	0.259	0.608	0.301
143TF7	0.569	0.266	0.589	0.287
831F75	0.578	0.272	0.592	0.290
834F75	0.574	0.287	0.595	0.298
C145F6N	0.570	0.271	0.585	0.287
C144F7, S144F7	0.570	0.271	0.585	0.287
T173F6	0.570	0.271	0.585	0.287
931F75	0.578	0.272	0.592	0.290
991F8	0.553	0.277 (8-12°C)	0.607	0.295
D200F7	0.561	0.259	0.608	0.301

CAUTION: Federal (United States) law restricts this device to sale by or on the order of a physician. See instructions for use for full prescribing information, including indications, contraindications, warnings, precautions, and adverse events.

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Edwards Lifesciences
One Edwards Way, Irvine CA 92614 USA
edwards.com



Persons/Groups Consulted

Clinical Nurse Specialist, Cardiology

Nurse Educator, ICU

Nurse Educator, CSICU

Medical Director, CICU

Medical Director, ICU

Physician Lead, Acute Heart Failure/Transplant Service

Revised By:

Nurse Educator, CICU

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