The Alarms Keep Going Off: Tips and Tricks

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67-year-old with NSTEMI

- 67-year-old man presented with chest pressure and hypotension
- PMHx: HTN, HPL, DM, dyslipidemia, COPD
- Cardiac history: PTCA of LAD, RCA 2010
- Troponin: 2.9 ng/dL
- EKG: dynamic anterolateral ST changes
- BP: 98/45 mmHg
LM – Low EF
LAD – 4.0x12 mm DES
LCX – 3.0x22 mm DES
Kissing Balloon

LAD - 3.5x20 mm NC
LCX - 3.5x15 mm NC
Final results
Transferred to the CCU
CCU Team

**Advanced Heart Failure**
- Heart failure management
- MCS management + weaning
- Advanced support options

**Intensivist**
- Manage ventilator
- Non-cardiac issues

**Perfusionist**
- Manage ECMO

**Cardiac surgery**
- Evaluate surgical options (LVAD, etc)

**Subspecialty care**
- Nephrology, ID, etc.
CCU Management

CCU Arrival
- Examine
- Vascular Access
- Catheters
- Drips
- Ventilator

Monitoring
- Clinical signs
- Hemodynamics
- Urine output
- EKG
- Access site
- Echo
- Lab (sVO\textsubscript{2}, ACT, pH, lactate, BMP, CBC)

Management
- Anticoagulation
- Inotropes
- Vasopressors
- MCS
- Ventilator
- Lab
Access
Hemodynamic
Metabolic
Access

Flow fluctuations “chugging”

Bleeding

Ischemia
Access

Flow fluctuations “chugging”
- Kinked cannula
- Poor cannula tip
- Excessive pump suction
- Decreased venous pressure

Bleeding

Ischemia
Flow fluctuations “chugging”

- Kinked cannula
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Bleeding

- Check the cannula. Is it kinked?
- Patient repositioning may be helpful
- Oxygenator and pump clotting

Ischemia
Access

Flow fluctuations “chugging”
- Kinked cannula
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Bleeding
- Check the cannula. Is it kinked?
- Patient repositioning may be helpful
- Oxygenator and pump clotting

Ischemia
- Fluids resuscitation
- Turn pump speed down
- Reposition the canula in cath lab
- Replace the canula
Access

Flow fluctuations
"chugging"

Bleeding
- Canula pulled out
- High ACT
- Dissection

Ischemia
Flow fluctuations “chugging”

Bleeding
- Canula pulled out
- High ACT
- Dissection
- Hemolysis

Ischemia

Check canula position
- Haptoglobin, LDH
- Lower ACT target
- Vascular doppler
- Vascular surgery consultation
- Replace the canula
- Femostop, pressure dressing, repositioning, sutures, bone wax
Access

Flow fluctuations “chugging”

Bleeding

Ischemia

Arterial thrombosis

Hematoma

Femoral arterial cannula is too large to allow retrograde perfusion
Access

Flow fluctuations “chugging”
- Hourly pulse check
- Make sure ACT is therapeutic
- Doppler US to evaluate flow
- CT scan to r/o RP bleeding
- Occlusive sheath/canula bypass

Bleeding

Ischemia
- Arterial thrombosis
- Hematoma
- Femoral arterial cannula is too large to allow retrograde perfusion
Occlusive Sheath Management
Solutions for Occlusive Sheaths

1. Peel away sheath
2. External Ipsilateral bypass technique
3. Internal contralateral bypass technique
4. External contralateral bypass technique
Solutions for Occlusive Sheaths

1. Peel away sheath
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Impella® Peel Away Sheath

- Peel away 13/14 Fr sheath
- Impella repositioning sheath is a tapered 9 to 14 Fr sheath
  - Prevent bleeding
  - Less likely cause impeding blood flow
- Most of the times, there is improved blood flow to the corresponding leg.
Solutions for Occlusive Sheaths

1. Peel away sheath
2. External Ipsilateral bypass technique
3. Internal contralateral bypass technique
4. External contralateral bypass technique
External Ipsilateral Bypass Technique

• EIA or CFA sheath occlusion
• Downward stick (distal to the sheath) of ipsilateral SFA
• Insert 4 or 5 Fr short sheath
• Connect side arm of antegrade sheath using male-to-male connector to:
  • Side arm of contralateral 6 Fr sheath
  • Side arm of large bore sheath
Antegrade Access

Downward micropuncture access (distal to the sheath) of ipsilateral SFA
Antegrade Access

4 or 5 Fr short sheath
External Ipsilateral Bypass

• Connect side arm of antegrade sheath using male-to-male connector to side arm of large bore sheath
  – **Left CFA** - **6F** 11 cm sheath
  – **Left CFA (antegrade)** - **6F** 11 cm sheath
• One important fact is not to advance repositioning sheath to Impella sheath to avoid covering of side arm
Solutions for Occlusive Sheaths

1. Peel away sheath
2. External Ipsilateral bypass technique
3. **External contralateral bypass technique**
4. Internal contralateral bypass technique
External Contralateral

- Connect side arm of antegrade sheath using male-to-male connector to side arm of **contralateral** 6 Fr sheath
  - Left CFA - 6F 11 cm sheath
  - Right SFA (antegrade) - 5F 11 cm sheath
Solutions for Occlusive Sheaths

1. Peel away sheath
2. External Ipsilateral bypass technique
3. External contralateral bypass technique
4. Internal contralateral bypass technique
Internal contralateral bypass technique

• In case of SFA occlusion → antegrade access is not an option
• Profunda artery which usually gives collateral to the lower leg
• **Internal contralateral bypass**
  • Contralateral 7Fr sheath
  • Glide Advantage wire advanced around the occlusive sheath → PFA
  • 4Fr long sheath (45 or 55 cm) sheath directly to PFA
  • Connect side arms of “mother and donor” using the male to male connectors
Internal contralateral bypass technique

Occlusive left sheath. Using Contralateral 7Fr sheath, IMA catheter is advanced over Glide Advantage wire.

Over Glide Advantage wire advance long 4Fr (45 or 55 cm) is advanced into the profundal femoral artery.

Connect side arm of the 7Fr sheath to the 4Fr sheath using male-to-male connector.
Internal Contralateral Bypass

- 7 Fr “mother” sheath
- 4 Fr “daughter” sheath
- Male-to-male connector
- Contralateral 7Fr sheath
- Large bore sheath
- 4 Fr “daughter” sheath
Internal Contralateral Bypass

- Large bore sheath
- 4 Fr “daughter” sheath
- Contralateral 7Fr sheath
- Male-to-male connector

Contralateral Bypass
Access

Hemodynamic

Metabolic
Hemodynamic

- ↓ Cardiac output
- ↓ CPO
- ↓ Urine output
- ↑ Lactate
- Inotrope dependent
- No pulsatility
Impella Console

- Catheter Model
- Alarm Window
- Aortic Placement Signal Waveform
- Pulsatile Motor Current
- Mean Flow

Performance Level

- MUTE ALARM
- FLOW CONTROL
- DISPLAY
- PURGE MENU
- MENU
Imaging-guided Impella Position

- Correct placement across the aortic valve is critical to avoid complications including hemolysis, suction episodes and inadequate hemodynamic support.
- The aim is to place the inlet approximately 3.5 cm distal to the aortic valve.
What to Expect in Case of Impella Malposition

- Hemolytic Anemia
- Hematuria
- Decreased flow
- Suction and placement alarms
- Hemodynamic changes
Confirm Placement

Left sided Impella → 2D ECHO

Right sided Impella → Chest X-ray
The Impella® device is **Preload** dependent and **Afterload** sensitive.

Goal CVP >10 & PCWP > 10
P-A-P

**Preload**
- The pressure or volume in the ventricle at end diastole
- **Target**: CVP >10 & PCWP > 10

**Afterload**
- The pressure or resistance the ventricle must overcome to eject blood
- **High in ECMO, high SVR, pressors, high MAP**

**Positioning**
- Correct positioning is vital to its function and patient outcomes
Impella Position In Ventricle
Impella® Catheter is completely in the aorta or if the inlet and outlet areas are in the ventricle and the open pressure area is in the aorta.
Predictors of Survival at 12-24 hours (N=75)

LACTATE

<table>
<thead>
<tr>
<th>CARDIA C POWER OUTPUT</th>
<th>&gt; 0.6</th>
<th>≤ 0.6</th>
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<tbody>
<tr>
<td>≥4</td>
<td>63% Survival (n=5/8)</td>
<td>30% Survival (n=3/10)</td>
</tr>
<tr>
<td>&lt;4</td>
<td>96% Survival (n=45/47)</td>
<td>80% Survival (n=8/10)</td>
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(On Behalf of the NCSI Investigators)
RV Failure as defined by Recover Right1:
- CI < 2.2 L/min/m² (despite continuous infusion of ≥ 1 high dose inotrope, ie, da/dobutamine ≥ 10 µg/kg/min or equivalent) and any of the following:
  - CVP > 15 mmHg, or
  - CVP/PCWP or LAP ratio > 0.63, or
  - RV dysfunction on TTE (TAPSE score ≤ 14 mm)

Worsening clinical, echocardiographic & hemodynamic parameters (concordant):
- ↓ Cardiac output
- ↓ CPO
- ↓ Urine output
- ↑ Lactate
- Inotrope dependent
- Absent pulsatility

\[
CPO = \frac{(MAP \times CO)}{451} \\
PAPi = \frac{sPAP - dPAP}{RA}
\]

CPO remains < 0.6 After 24 hours

- PAPi ≤ 0.9 (RV Failure)
  - Biventricular support with Impella RP® on the right side (transfer if not available)

- 0.9 < PAPi ≤ 1.5 (RV dysfunction)
  - Consider supporting the right side with Impella RP (transfer if not available)

- PAPi > 1.5 (acceptable RV)
  - Consider left-side escalation LVAD, OHT

Assess for Myocardial Recovery
(At least every 12 hours)

**Improving**
Clinical, Echocardiographic & Hemodynamic parameters (concordant):
- ↑ Cardiac output
- ↑ CPO
- ↑ Urine output
- ↓ Lactate
- Inotropes low dose/discontinued
- Adequate Ramp test

**Mixed picture**
Clinical, Echocardiographic & Hemodynamic parameters (discordant):
- Some parameters are improving
- Pressors lowered but not discontinued
- Fails weaning trial

**Worsening**
Clinical, Echocardiographic & Hemodynamic parameters (concordant):
- ↓ Cardiac output
- ↓ CPO
- ↓ Urine output
- ↑ Lactate
- Inotrope dependent
- Absent pulsatility

**Myocardial Recovery**
Wean & Explant MCS (After a minimum of 48h)

**Inadequate Recovery**
Continue MCS support & frequent clinical reassessment
Failure to recover within 48-72 h, consider escalation or durable VAD/transplant

**No Recovery**
Escalate or Transfer
LVAD – Heart transplant
Thank you

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