Atrial thrombus, Fibrin Sheath and Catheter Recirculation – What’s the optimal management

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Catheter Dysfunction

• Early dysfunction
  – Poor placement techniques

• Late dysfunction
  – Thrombosis
  – Fibroepithelial sheath formation

Catheter related thrombosis

• Catheter thrombosis
  – Intraluminal
  – Extraluminal

• Physiological process starts with endothelial damage during insertion
• Propagation of inflammatory and coagulation cascade
• Inadequate and improper flushing during dialysis
• Inadequately filling of the lumen with anticoagulant

Intraluminal Thrombus

• Often due to improper handling and care during dialysis
• Higher incidence in femoral CVC than U CVC
• Effect of gravity and difference in viscosity between heparin and blood leads to leakage
• Leakage of heparin is more in catheters with multiple side holes

• Extraluminal thrombus
  – Central vein thrombus
  – Right atrial thrombus

• Presence of CVC can lead to thrombus formation in the central vein
• Central vein thrombus is generally asymptomatic
• Incidence reported in literature – 2-64%
• Two common associated risk factors
  – Duration of CVC
  – Infection
Superior Vena Cava Thrombosis

- Multiple hardware as in patients with cardiac rhythm device
- SVC stenosis

Central Vein thrombosis

Incidence is higher with left sided catheters


Right Atrial Thrombus

- Relatively uncommon
- Detected on angiography
- Large thrombus defined as >2cm
- Additional studies such as TEE required for diagnosis
- CVC malfunction because tip is embedded in the thrombus
- Serious complication such as hemoptysis
- High mortality – 27%


Courtesy of Aslam Pervez, MD
Management of thrombosis

- Intraluminal thrombosis
  - Prevention
    - Catheter lock solution
  - Treatment
    - Thrombolytics
    - Exchange over a guide wire

Management of right atrial thrombus

- Removal of CVC
- Systemic anticoagulation for at least 6 months
- Low risk patients - surgical thrombectomy
- High risk patients - appropriate management not established
- Weekly monitoring with echocardiography is recommended

Fibroepithelial sheath

- Develops within 24hrs of placement
- Full length sheath can develop in 5-7 days
- Fibrin sheath is not fibrin, but connective tissue
- Endothelial damage leads to collagenous layer produced by smooth muscle cells
- One-way valve effect
- Thrombus formation at the tip can occlude the lumen completely

Fibrin Sheath

- Stripping
- Balloon disruption

Treatment for fibrin sheath

- Stripping
- Balloon disruption


Stripping of sheath

- Snare catheter through femoral approach
- Immediate success – 78-98%
- 3-month patency – 45-60%
- 6-month patency – 28-45%
- No major complications reported
- Disadvantage:
  - Cost
  - Discomfort from additional femoral puncture

Balloon disruption

- More commonly performed
- Randomized controlled trial with 47 patients
- Results

<table>
<thead>
<tr>
<th></th>
<th>Without disruption</th>
<th>Disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median time to dysfunction</td>
<td>97.5 days</td>
<td>373 days</td>
</tr>
<tr>
<td>Qb</td>
<td>329 ml/min</td>
<td>340 ml/min</td>
</tr>
<tr>
<td>URR</td>
<td>66%</td>
<td>73%</td>
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</tbody>
</table>

- Study not adequately powered for patency analysis
- Larger study needed for definitive treatment strategy

Balloon Disruption of Fibrin Sheath

- Small non-randomized, retrospective study
- 66 consecutive patients with dysfunctional catheters
- Compared simple exchange vs. striping vs balloon disruption
- Technical success rate, complication rate, and cumulative patency rate at 1, 3 and 6 months was identical


Catheter Recirculation

- Recirculation occurs when blood returning from the venous port of the catheter re-enters the arterial port of the catheter without passage through the circulation.
- >10% is considered significant for catheters
- Reversal of ports a common practice
  - Often unavoidable
- Routine monitoring per K/DOQI guidelines
  - Inability to achieve prescribed Qb
  - High dialysis venous/arterial pressures
- Timely recognition and intervention
Recirculation

- Common with non-tunneled CVC than tunneled catheters
- Non-tunneled catheters
  - Port reversal increases recirculation - 3-6 fold
  - Femoral placement higher incidence
  - Shorter catheters 13.5 cm vs. 19 cm especially in femoral vein


Recirculation-Human data

- 18-34% RR in step tip CVC with line reversal
- Trerotola et al reported higher RR in step tip catheters compared to split tip
- Moossavie et al CVC RR to independent of catheter design or site in 165 patients


Tunneled catheters

- Animal study by Tal using symmetrical tip, split tip and staggered tip catheters
- Recirculation measured at
  - 300, 400 and 500 ml/min with standard connection
  - 400 ml/min with reversed connection
  - Tip placed in SVC and right atrium
- Symmetric catheter had minimal recirculation compared to other tips

Recirculation-Human data

- Clinical significance - Inadequate dialysis
- Alternatives
  - Increase the duration of dialysis
  - Maximize the dialysis flow
- Moist et al reported:
  - 41.7% recirculation in prevalent dialysis population
  - 28% with standard connection
  - 71% with reversed connection
  - Adequacy (URR >65%) achieved in 80% with Qb >250 ml/min
  - Study concluded: RR is marker for dysfunction but not necessarily the only indicator for intervention


Summary

- Inadequate data to recommend or formulate guidelines to treat catheter related atrial and central vein thrombosis
- Currently available data suggests balloon disruption of fibroepithelial sheath may be acceptable. Comparative randomized studies are needed
- Inadequate dialysis resulting from catheter recirculation can be partially circumvented by extending the duration of dialysis.

Thank You