Retained Fibrin Sheaths: A Common CT Finding after Long-Term Indwelling Central Venous Catheter Removal

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Disclosure

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Purpose - introduction

• Fibrin sheaths form on long-term central venous catheters
• The reported frequency is 42-100%, within 7 days
• The process involves:
  – Endothelial damage, thrombus formation, smooth muscle activation, collagen deposition, and sometimes calcification
• The thrombus may:
  – bridge the vein wall and catheter, form a sleeve on the distal tip of the catheter, form a mural thrombus on the vein wall

• During catheter removal these sheaths remain in the vein
Retained fibrin sheath - CT
Purpose – the literature

• No serial studies describing fibrin sheath remnants on CT
• There is a low awareness of their CT appearances
• This has led to misinterpretation of the CT findings
• Case reports describe instances in which fibrin sheaths were misdiagnosed as retained catheter fragments
• Surgical exploration of a presumed foreign body which was later found to be a calcified fibrin sheath
Purpose – the study

• Evaluate the prevalence of retained fibrin sheaths on chest CT in patients who have had a removal of a central venous catheter:
  – To describe their CT appearance
  – Patient-specific characteristics
  – Complications associated with retained fibrin sheaths
Materials and Methods:

- A retrospective study
- Performed at Montefiore Medical Center and at Tel Aviv Sourasky medical center, approved by the IRB at both institutions

Inclusion criteria:
- Line removal between 01/2008 and 07/2009 and had a chest CT scan after line removal
- Included line types: Tunneled catheters, implantable ports and peripherally inserted central catheters (PICCs)
Materials and Methods:

• A retrospective study

• Performed at Montefiore Medical Center and at Tel Aviv Sourasky medical center, approved by the IRB at both institutions

• Inclusion criteria:
  • Line removal between 01/2008 and 07/2009 and had a chest CT scan after line removal
  • Included line types: Tunneled catheters, implantable ports and peripherally inserted central catheters (PICCs)
  • Duration of less than 7 days excluded
Materials and Methods: study group

- 147 adults
- 77 men and 70 women, mean age of 58 yrs (21-91)
  - 72 patients from Montefiore Medical Center
  - 75 patients from TASMC
Materials and Methods:

• Chest CT scans for each patient were reviewed:

• Retained fibrin sheath were defined as a filling defect, central or mural, linear or tubular, calcified or not, within the venous system

• Venous occlusion / stenosis, venous collaterals and pulmonary embolism, were noted, when possible
Materials and Methods: the CT protocols

- 50 non-contrast CT scans
- 83 contrast-enhanced CT scans
- 14 both non-contrast and contrast enhanced CT scans
Materials and Methods:

• The prevalence of fibrin sheath remnants was calculated

• Bivariate analyses with Chi-square / Fisher’s exact tests were performed to assess for a relationship with:
  • co-existing complications,
  • age,
  • sex
  • diagnosis leading to catheter placement

• Logistic regression

• Relationships with a $p$ value $\leq 0.2$ on bivariate analysis were included in the regression model
Results:

• The prevalence of retained fibrin sheaths was 13.6% (20/147)

• The remnants were calcified in 9 patients (45%)

• Non-calcified sheaths were conspicuous on contrast enhanced CT

• Calcified sheaths were conspicuous on NCCT

• The most common appearance was a small filling defect in the central venous system
A small hypodense filling defect in the right Internal Jugular vein
Results:

- Fibrin sheath measured mostly 1.5 to 5 mm
- Longest sheath remnant was 16cm long!
Fibrin Sheath remnants were also found in the sub cutaneous tunnel.
Results:

- Women > men;
  - 23% of women
  - 5% of men
- (16/70 and 4/77 respectively, p=0.0018)
## Results:
### Relationship Between Fibrin Sheath Remnants and Venous Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Prevalence in patients with retained fibrin sheaths (n = 20)</th>
<th>Prevalence in patients without retained fibrin sheaths (n = 127)</th>
<th>P value (significant &lt; 0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venous Occlusion</td>
<td>30% (6)</td>
<td>5% (6)</td>
<td><strong>0.0001</strong></td>
</tr>
<tr>
<td>Venous Stenosis</td>
<td>20% (4)</td>
<td>17% (21)</td>
<td>0.7015</td>
</tr>
<tr>
<td>Collateralization</td>
<td>30% (6)</td>
<td>6% (7)</td>
<td><strong>0.0003</strong></td>
</tr>
<tr>
<td>Pulmonary Embolus</td>
<td>5% (1)</td>
<td>5% (6)</td>
<td>0.9571</td>
</tr>
<tr>
<td>Infection</td>
<td>40% (8)</td>
<td>36% (46)</td>
<td>0.7445</td>
</tr>
</tbody>
</table>
### Multivariate logistic regression analysis

<table>
<thead>
<tr>
<th>Patient-specific Characteristics</th>
<th>Odds Ratio</th>
<th>Confidence Interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.998</td>
<td>0.961-1.037</td>
<td>0.92</td>
</tr>
<tr>
<td>Female sex</td>
<td>7.018</td>
<td>1.787-27.572</td>
<td><strong>0.005</strong></td>
</tr>
<tr>
<td>Venous occlusion</td>
<td>0.135</td>
<td>0.029-0.636</td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Collaterals</td>
<td>0.339</td>
<td>0.080-1.432</td>
<td>0.14</td>
</tr>
<tr>
<td>End-stage renal disease</td>
<td>0.51</td>
<td>0.160-1.628</td>
<td>0.26</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>4.271</td>
<td>0.777-23.489</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Discussion:

• Although millions of catheters are inserted and removed every year, to our knowledge, only a handful of reports describe fibrin sheath remnants remaining within the venous lumen

• Associated complications with fibrin sheath retention have been proposed by venographic studies

• However, to our knowledge, no serial study has examined these associations with CT
Discussion:

- Our study demonstrates that fibrin sheath remnants are identified on CT in a substantial minority of patients, with a prevalence of 13.6% (20/147)

- The true prevalence could be even higher:
  - time from removal to CT scan
  - scan protocols

- Higher incidence in women
  - Matches findings of venographic studies
  - Women's veins are smaller, same size catheters
Discussion:

• Changes over time:
  – Calcification of a previously non-calcified sheath in one case
  – Sheath remnants were demonstratively smaller on subsequent examinations in other cases
Fibrin sheath remnant: calcification over time
Discussion: limitations

• Retrospective study:
  – CT protocols were not optimized for fibrin sheath remnant detection
  – Time from removal to CT scan
  – Differences in catheters size and properties
Discussion: Clinical implication?

• The study was not design to assess the clinical implications of fibrin sheath remnants:
  – Anti coagulation??
  – Follow up studies to resolution??

• Further studies are needed in order to address these questions
Conclusion:

- Retained fibrin sheaths are present on CT in a substantial minority of patients following CVC removal;
- Nearly half are calcified
- They are more common in women and are associated with venous occlusion
Conclusion

• Increase awareness of this under-reported phenomenon

• Should not be mistaken for a DVT or catheter fragments
the End