Localized intravascular coaguloopathy (LIC)

- Subset exhibit localized intravascular coaguloopathy (LIC) ➔ pain, thrombosis & excessive bleeding during surgical procedures
- LIC can progress to disseminated intravascular coaguloopathy (DIC) and life-threatening hemorrhage
- size of VM/depth of VM (particularly intramuscular) and presence of phleboliths are associated with LIC

Coagulation disorders in venous malformation

LIC: D-dimer > 1,000 ng/mL a/o fibrinogen <200 mg/dL
- incidence between 42% and 88%
- lesion size (P < 0.001), presence of phleboliths (P = 0.005)

DIC: conversion of LIC to DIC
- consumption of platelets and coagulation factors
- increase in PT & decrease in FV earliest signs of bleeding and consumption of platelets and coagulation factors

acquired von Willebrand factor syndrome (AVWS): diagnostic workup remains difficult

Association of LIC with venous malformations

- Prospective, consecutive series
- 140 patients with VM
  - 59 (42%) high D-dimer levels
  - 6 (4.3%) low fibrinogen (85-176 mg/dL), 1 (0.7%) < 100 mg/dL
    ➔ these patients had very high D-dimer levels (1.9-9.0 mg/dL), and 1 had a low platelet count (114 x 10^3/μL)
- none exhibited PE as observed in KTS

Multivariate analysis

n=135, venous malformation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR (95% CI)</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Sex (male vs female)</td>
<td>1.68 (0.72-3.87)</td>
<td>.12</td>
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<tr>
<td>Localization: trunk</td>
<td>2.79 (0.81-8.55)</td>
<td>.10</td>
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<tr>
<td>Surface ≤10 cm²</td>
<td>2.82 (1.24-6.39)</td>
<td>.01</td>
</tr>
<tr>
<td>Palpable phlebolith(s)</td>
<td>3.16 (1.40-7.09)</td>
<td>.006</td>
</tr>
</tbody>
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Pediatric Radiology 2015, 45 (11), 1690-1695
Management algorithm

- Fibrinogen normal, not necessary to treat chronic LIC
  - Elastic compression to minimize blood stasis
- Elevated D-dimer associated with pain (thrombosis)
  - Low dose LMWH (100 IU/kg/d)
- Low fibrinogen with potential of aggravation to DIC
  - Preventive management by LMWH before any interventional procedure (100 IU/kg/d)
- Aspirin low efficacy (contrary to Kasabach-Merritt phenomenon, platelets are not involved in LIC)
- OAC decrease level of coagulation factors, not sufficient to prevent thrombin formation in LIC

D-dimer levels before and after treatment with LMWH for painful venous malformation

Kasabach–Merritt vs venous malformation

- VM-associated LIC is a distinctive lifelong coagulopathy that must be differentiated from KMS
  - Predominance of coagulation factor consumption
- LMWH
- Kasabach–Merritt syndrome (KMS) or phenomenon is a profound thrombocytopenia related to platelet trapping within a vascular tumour of infancy, either a kaposiform haemangioendothelioma or a tufted angioma
  - Predominance of platelet consumption
  - Corticosteroids, interferon α, vincristine and platelet inhibitors

Sclerotherapy complications

N=127, sclerotherapy for venous malformation

4 (3.1%) severe complications, all related to coagulopathy

- Non-treated
- 4 (3.1%)
- Thrombosis
- 3 (2.3%)
- Pneumothorax
- 1 (0.8%)
- Hypoalbuminaemia
- 1 (0.8%)
- Subcutaneous haematoma
- 1 (0.8%)
- Infection
- 1 (0.8%)

Management of DIC with rivaroxaban in Klippel–Trenaunay syndrome (case report)

LIC/DIC manifest as hemorrhage and thrombotic events

emergency (DIC), UFH with monitoring via aPTT ➔ stop of bleeding and termination of DIC
followed by rivaroxaban ➔ no recurrent DIC @ 1 year;
acquired von Willebrand’s disease no longer present

Conclusion
• Rivaroxaban highly effective in controlling both clinical and laboratory DIC
• favourable treatment option in KTS

Blood Coagulation and Fibrinolysis 2013, 24:766–770

Rivaroxaban for treatment of LIC in venous malformation (case report)

LMWH recommended in LIC: invasive procedures, active bleeding, very low fibrinogen levels (0.5–1.0 g/L) associated with a bleeding diathesis

Evolution of markers of intravascular coagulation

Conclusion
Higher VM severity scores associated with more severe LIC
Sclerotherapy, surgery or pregnancy can trigger conversion to DIC, with bleeding related to factor consumption
Low dose of LMWH (100 IE/kg) recommended in LIC with recurrent pain and before invasive treatment
Therapeutic dose of LMWH is recommended in LIC with DVT
NOACs seem to have comparable efficacy and might become an ideal oral treatment alternative to LMWH