CT = Clotting Time

Parameter: Clotting Time
**CT** - Clotting Time (seconds) – The time from the start of the test until first significant levels of a clot are detected. This measurement is initiated by adding a clot activator until an amplitude of 2 mm is reached.

**Description:** CT - Clotting Time (seconds) – The CT describes how rapid fibrin formation starts. This parameter is related to, but not identical to the clotting time in a standard coagulation test for plasma.

CT (clotting time): => initiation of clotting, thrombin formation, start of clot polymerization

**Clinical Application:** The CT parameter facilitates the decision to substitute clotting factors (e.g. FFP, thawed plasma or anticoagulant antidotes such as protamine)

CFT = Clot Formation Time

Parameter: Clot Formation Time (CFT)
**CFT** - Clot Formation Time (seconds) – The time from the measurement of CT until a fixed level of clot firmness. The CFT is the time between 2 mm amplitude and the 20 mm amplitude of the clotting signal.

**Description:** CFT - Clot Formation Time (seconds) – The CFT describes the rate of initial clot formation mediated by thrombin-activated platelets, fibrin and activated factor XIII (FXIIIa)

CFT (clot formation time): => fibrin polymerization, stabilization of the clot with Platelets and F XIII

**Clinical Application:** The CFT is a complementary parameter facilitates the decision to substitute with platelet concentrate or fibrinogen containing products, such as FFP or cryoprecipitate or both. A shortened CFT may be observed in a hypercoaguable state.

α-angle

**α-angle** - The angle between the baseline and a tangent to the clotting curve through the 2mm CT point.

**Description:** α-angle - Describes the kinetics of clotting. Therefore, a larger alpha angle reflects the rapid clot formation mediated by thrombin-activated platelets, fibrin and activated factor XIII (FXIIIa); CFT becomes shorter as the alpha angle becomes larger.

α-angle => the faster the clot builds increases the amplitude which is indicative of increased clot stability.
**Clinical Application:** This parameter correlates to the parameter, CFT. Smaller \(a\)-angles typically suggest thrombocytopenia or hypofibrinogenemia. Whereas, a large \(a\)-angle may be observed in hypercoagulable states.

Parameter: A10 (or A20) Amplitude (x) after CT

**A10 \(=\) (mm)** – The clot firmness at the amplitude time point of 10 minutes after CT.

**Description:** A10 \(=\) (mm) – Amplitude 10 represents the clot firmness at 10 minutes after CT.

**Clinical Application:** Directly relates to and is highly predictable to the MCF. Often it facilitates a decision to use platelet concentrate or fibrinogen containing components when the amplitude/value is below established reference ranges.

Parameter: Maximum Clot Firmness

**MCF \(=\) (mm)** – The MCF - Maximum Clot Firmness measures clot firmness, thus, overall clot stability.

**Description:** MCF is the maximum amplitude that is reached prior to clot being dissolved by fibrinolysis.

**Clinical Application:** A low MCF suggests decreased clot firmness, whereas, an elevated MCF may indicate a hypercoagulable state. MCF correlates to A20.

Parameter: Lysis Index (x) LI (30), LI (60)

**Lysis Index \(=\) (%)** – The Lysis Index is a parameter representing fibrinolysis at a determined time point. It correlates to the MCF (Clot % remaining).

**Description:** LI30 for example, describes the remaining clot firmness 30 minutes after CT, whereas, LI60 describes the remaining clot firmness 60 minutes after CT.

**Clinical Application:** In most cases, an abnormal LI30 suggests hyperfibrinolysis, therefore, this parameter’s result may prove beneficial when deciding upon anti-fibrinolytic drug therapy. In other cases hyperfibrinolysis can occur later, thus, LI60 may also be a useful clinical indicator.

Parameter: Maximum Lysis (ML)

**ML \(=\) (%)** – Maximum Lysis is a parameter that describes the degree of fibrinolysis relative to the MCF achieved during the measurement. (Percent reduction of clot firmness after MCF in relation to MCF).

**Description:** A ML of 5% means that during a selected period of observation, the MCF decreased by 5%.

**ML (Maximum Lysis):** \(=>\) is not calculated at any fixed time, rather it is defined as the % of lysis at the end of the measurement.

**Consider:** Total run time and the time after MCF.

**Clinical Application:** ML (maximum lysis): Evaluate in conjunction with Lysis Index.

ML \(=>\) stability of the clot (ML < 15%) or fibrinolysis (ML > 15% within 1h)
US NORMAL REFERENCE RANGES

<table>
<thead>
<tr>
<th>ASSAY</th>
<th>CT (sec)</th>
<th>CFT (sec)</th>
<th>$\alpha$ °</th>
<th>A10 (mm)</th>
<th>A20 (mm)</th>
<th>MCF (mm)</th>
<th>LI30 (%)</th>
<th>ML (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEM</td>
<td>122-208</td>
<td>45-110</td>
<td>70 - 81</td>
<td>51-72</td>
<td>51-72</td>
<td>na</td>
<td>&lt; 15</td>
<td></td>
</tr>
<tr>
<td>EXTEM</td>
<td>43 - 82</td>
<td>48 - 127</td>
<td>65 - 80</td>
<td>50-70</td>
<td>52-70</td>
<td>na</td>
<td>&lt; 15</td>
<td></td>
</tr>
<tr>
<td>FIBTEM</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>7 - 24</td>
<td>7 - 24</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>APTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEPTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

**ONE PUBLISHED ROTEM ALGORITHM**

![ROTEm Algorithm Diagram](image)

Fig 6. A proposed transfusion algorithm in bleeding patients based on conventional coagulation and ROTEM parameters. For an explanation of the abbreviations of the ROTEM parameters, please refer to Table 1.

Bolliger, D, Seeberger, M, Tanaka, K.; Principles and Practice of Thromboelastography in Clinical Coagulation Management and Transfusion Practice. 2011

NOTES:
### Table 3. Example of ROTEM-Based Hemostasis Management

<table>
<thead>
<tr>
<th>Clot Firmness</th>
<th>EXTEM-MCF Parameters</th>
<th>EXTEM-MCF</th>
<th>EXTEM-MCF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;35 mm</td>
<td>35-45 mm</td>
<td>&gt;45 mm</td>
</tr>
<tr>
<td>FIBTEM-MCF*</td>
<td>Cryoprecipitate</td>
<td>Cryoprecipitate</td>
<td>Cryoprecipitate</td>
</tr>
<tr>
<td>&lt;10 mm</td>
<td>† platelet 1 U</td>
<td>† platelet 1 U</td>
<td>If bleeding is uncontrolled</td>
</tr>
<tr>
<td>≥10 mm</td>
<td>Platelet 1-2 U</td>
<td>Platelet 1 U</td>
<td>Consider plasma or PCC based on EXTEM-CT as below</td>
</tr>
</tbody>
</table>

- Consider platelet transfusion in patients on P2Y12 inhibitors

### Prolonged CT values

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEM-CT/HEPTEM-CT ratio &gt;1.0</td>
<td>Residual heparin</td>
</tr>
<tr>
<td>EXTEM-CT &gt;100 s and/or INTEM-CT &gt;240 s</td>
<td>Low coagulation factors</td>
</tr>
<tr>
<td>FIBTEM-A_{10} &lt;5 mm</td>
<td>Very low fibrinogen (&lt;100 mg/dL)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protamine 25–50 mg</td>
</tr>
<tr>
<td></td>
<td>Plasma 10–15 ml/kg or PCC 20 IU/kg</td>
</tr>
<tr>
<td></td>
<td>Cryoprecipitate as above</td>
</tr>
</tbody>
</table>

### Fibrinolysis Patterns

<table>
<thead>
<tr>
<th>Diagnosis†</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrinolysis &lt;20 min</td>
<td>Fulminant fibrinolysis</td>
</tr>
<tr>
<td>Fibrinolysis in 20-40 min</td>
<td>Early fibrinolysis</td>
</tr>
<tr>
<td>Fibrinolysis &gt;40 min</td>
<td>Clot retraction or late fibrinolysis</td>
</tr>
<tr>
<td></td>
<td>1–2 g TXA or 5–10 g EACA‡</td>
</tr>
</tbody>
</table>

- For fibrinogen replacement, cryoprecipitate 10 U is administered. Plasma-derived fibrinogen concentrate 2 g can be an alternative. If FIBTEM-MCF is below 5 mm, double the dose of cryoprecipitate.
- *FIBTEM-A_{10} at 8 mm may be used as a cutoff instead of FIBTEM-MCF at 10 mm.
- †Repeat EXTEM and APTErr after therapeutic interventions.
- ‡Use anti-fibrinolytic agents only if the risk of bleeding is greater than the risk of thrombosis or worsening of disseminated intravascular coagulation.
- Plasma indicates fresh-frozen or thawed plasma; PCC, prothrombin complex concentrate; TXA, tranexamic acid, EACA, ε-aminocaproic acid.

NOTES:
Example #1

(Bleeding) Normal Range = 50-70 MCF Platelets or Plasma? Fibtem?

Example #2

Fibtem = Normal range - 9 - 24 MCF
Fibrinogen = Normal range > Platelet therapy

Clinical Bleeding? Normal range= 50-70 MCF > Platelets or Plasma? Fibtem?

Fibtem very low > Cryo &/or FFP
Example #3

Residual Heparin post protamine

Fibtem = low normal

Example #4

Hyperfibrinolysis

Aptem > Confirms Hyperfibrinolysis

Correct hyperfibrinolysis first

Fibtem > no fibrinogen detection "flat line" > Cryo

Platelets