

**Cardiac Arrest Center  
of Excellence**

**TTM protocol**

Eligibility criteria: all comatose survivors after cardiac arrest

**Induction:** TTM (Targeted Temperature Management) should be initiated immediately after admission to the ICU or continued if EMS started cooling

**Target/Maintain:** Temperature of 33°C for 24 hours, to be reached as quickly as possible

**Re-warming:** to be performed with a controlled rate of 0.25°C/hour up to 37°C

*Admission procedure: consider flowchart*

*After admission call study coordinator*

**TTM step-by-step approach:**

1. Esophageal temperature probe is preferred for TTM; bladder probe is possible but less accurate (e.g. ARF).
2. Perform deep analgesia and sedation with benzodiazepin and opioid, if necessary add propofol or ketamine. Only stop analgesia and sedation after re-warming to normothermia (>36°C). Inhalative sedation (Isoflurane) should always be taken into account because of its short half-life time (important for prognostication).
3. Counterwarming should be initiated right from the beginning to prevent shivering. Only paralyze patient if shivering is present in deep analgesia and sedation and if magnesium iv. and counterwarming with socks and gloves do not improve the situation.
4. Antibiotics are not mandatory. Only necessary if aspiration is likely to have happened or during invasive procedures.
5. Use cold saline or cool packs to speed up induction of cooling.
6. Plan necessary procedures as soon as possible (angiography/PCI or CT); discuss all patients whether there is an indication for PCI with cardiologist even NSTEMI if the first rhythm was shockable (pVT or VF).
7. After 24h start to re-warm at a rate of 0.25°C/hour.
8. Stop sedation only after return to normothermia (>36°C).
9. In order to prevent rebound fever leave cooling device on the patient for another 24h after return to normothermia.
10. During cooling control for:
  - pCO<sub>2</sub> 35-40mm Hg
  - Blood sugar levels below 180-200mg/dL
11. Invasive monitoring consider SOP
12. All nursing activities can be done during TTM treatment.
13. After admission send the neuro-diagnostics fax to Neurology Dept. for sSEP and EEG.
14. NSE should be determined after 72h.

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**Troubleshooting in TTM:**

1. During cooling
  - a. High need for volume resuscitation is common
  - b. Potassium and magnesium will decrease, therefore high requirement for electrolyte substitution especially if arrhythmias occur.
2. During maintenance
  - a. Bradycardia is common. In most cases this is not hemodynamically relevant. If patient does not tolerate raise target temperature 0.5°C higher. QTc time is physiologically prolonged.
3. During re-warming
  - a. Potassium will be released into the blood. Stop potassium substitution early, especially in patients with renal failure.
4. High temperature variation during maintenance
  - a. In oliguric patients bladder temperature probe can be insufficient. Better use esophageal probe as standard.
  - b. Is the sedation deep enough?
  - c. It might be due to counterregulation of the patient. Start counterwarming in order to prevent shivering.
5. Shivering
  - a. In most cases shivering occurs during cooling and desists when the target temperature is reached. That means that patients should be cooled aggressively. Consider adding more cold fluids or cool packs.
  - b. Is the sedation deep enough?
  - c. Magnesium 1-2g iv.
  - d. Counterwarming should be initiated right from the beginning → thermoreceptors in the patient can be deceived.
  - e. Paralysis if all other steps will not work
6. ECG
  - a. Bradycardia is common and not dangerous if patient is hemodynamically stable.
  - b. QTc time is prolonged (up to 550ms). Only in rare cases can this fact lead to a higher susceptibility for malignant arrhythmias because hypothermia tends to stabilize membranes.

***This SOP is a local recommendation for TTM and no official guideline. The patients' treatment remains in every case the responsibility of the doctor on duty. The Charité is not responsible for any possible harm caused by following this SOP.***