

## Induced hypothermia after cardiac arrest - experiences from Finland

In Finland mild therapeutic hypothermia treatment was first adopted in 1997 in the ICU of Helsinki University Hospital. This was due to participating in the HACA (Hypothermia after Cardiac Arrest) study, which was conducted through 1997-2000. With only a few exceptions the hypothermia treatment protocols, patient selection, medications and treatment strategies follow the HACA study protocol in Finland. The cooling method has changed after the study and the selection of sedative agents has been questioned. In Helsinki in 2001 19 patients were cooled in our department and in 2002 and 2003 41 and 36, respectively. In Jorvi Hospital in Espoo six patients were treated with hypothermia during the year 2003, four had a good recovery and two died. In Turku University Hospital since June 2003 ten patients have been treated, six recovered really well and one died. Oulu University Hospital has treated eight patients, six recovered well and two died. Also Tampere University Hospital treats patients with hypothermia and has started during the last year.

Patients with a witnessed collapse and VF as the primary rhythm and a ROSC time between 10-35 minutes are selected to receive hypothermia treatment. Helsinki has also treated patients with a longer time to ROSC (43 minutes) with good neurological recovery. If the patient regains consciousness while arriving in the emergency department, hypothermia is not considered. Usually, the prehospital team allows the patient to cool passively and informs the emergency department and/or ICU staff about the patient. Our aim is to minimise the time gap between ROSC and initiation of the hypothermia treatment and therefore the prehospital team is encouraged to bring the patient straight to the ICU, at least in Helsinki. If the electrocardiogram (ECG) shows signs of acute coronary ischemia, a cardiologist is consulted about the need of an urgent angiography. Other studies before hypothermia treatment may include a head CT scan in some cases.

The patients are sedated with a combination of midazolam (0.125mg/kg/hour) and fentanyl (2g/kg/hour), and a muscle relaxant (pancuronium 0.05 mg/kg/hour) is used to prevent shivering. Midazolam was originally used in the HACA study on the basis of a better haemodynamic stability, but the Helsinki ICU has recently discussed replacing it by propofol in

order to shorten the recovery period. Pancuronium may also be replaced by a shorter acting relaxant in the future and Oulu is already using cisatracurium.

Monitoring is usually limited to direct arterial pressure measurement, pulse oximetry, ECG, bladder temperature and hourly diuresis. Muscle relaxation is monitored with a nerve stimulator. A nasogastric tube is used to prevent aspiration. Central venous or pulmonary artery catheterisation are not needed in the Helsinki protocol, but the Oulu ICU still uses it for all patients. Mean arterial pressure goal is set individually. If a vasopressor is needed, the first choice is noradrenalin and the preferred inotropic agent is dobutamine. Fluid administration includes only crystalloids during the hypothermia treatment. The target blood glucose level is between 4 and 6 mmol/L in all patients in Helsinki, somewhat higher in the other hospitals.

Patients are cooled to 33°C and this temperature is maintained for 24 hours. Warming is slow (0.5°C/hour) and the target temperature is 35 - 36.5°C. Sedatives are stopped at 35°C and the patients are allowed to wake up when warm. Neurone specific enolase (NSE) is measured 24 and 48 hours after the cardiac arrest. Waking up may be slow and some patients may need several days for awakening. This may, among other reasons, be due to possibly altered metabolism of the sedative agents during hypothermia, and therefore we feel the follow up period should be sufficiently long. A neurologist is usually consulted already in the ICU period.

In Helsinki in the HACA study and until June 2002 the cooling was performed with a cooling mattress (KCI Mediscus Therakair or KCI Theracool) or a blanket. The Oulu ICU still uses a mattress (Allon Thermowrap method). Occasionally also external cooling with ice placed in the axillae has been used in Helsinki, when the intravenous system has been in use, and the methods have been supplemented with cold intravenous fluids. Since June 2002 most patients have been cooled with an intravenous cooling device (Alsuis Coolgard) and the external cooling methods have been used only occasionally. In the Jorvi, Kuopio, Tampere and Turku ICU the Coolgard has been used since they started the treatment. The catheter is inserted in the femoral vein. Insertion is easy using Seldinger

technique. By this time Helsinki ICU have not had any catheter related complications, Turku ICU has reported one catheter sepsis (Klebsiella). The hollow catheter provides a central venous line for correcting electrolyte disturbances. No additional anticoagulant therapy is needed since the catheter is heparin coated, but a basic thrombosis prophylaxis is used. No bleeding complications have been reported in Finland.

The cooling device is easy to prepare for use and simple to operate. Cooling is efficient and the set temperature goal is kept very stable. Importantly, the warming rate is well controlled (0.5°C/hour). Since the cooling catheter can be used for four days according to the manufacturer, we have continued controlling the temperature after the re-warming period by setting the target temperature to 36.5°C to avoid rebound hyperthermia. The intravenous technique has been found well functioning. The advantages include the controllability mentioned above, an easy access to the patient, small equipment easy to store and the additional central venous line. The disadvantages include the high price of the device, tubing and the catheter. Further, similar to the external cooling methods cooling rate depend on the size of the patient. However, the patients are usually cooled passively before arrival to the ICU and often the starting temperature is no more than 35°C reducing the significance of cooling efficiency.

Since November 2003, the Helsinki University Hospital has collected and reported patient information and cooling data on all hypothermia treated patients to a patient register run by Alsius.