Hyperthermia in Children
Information Brochure for Patients and Parents

Department of Radiation Oncology and Radiotherapy
Charité - Universitätsmedizin Berlin
Campus Virchow-Klinikum
Dear Patients,
Dear Parents,

In addition to chemotherapy and radiotherapy, we at the Charité - Universitätsmedizin Berlin university hospital have been using hyperthermia to treat adults and children in selected cases for over 25 years now. Hyperthermia is an additional treatment option alongside surgery, chemotherapy and radiotherapy for certain tumor cases and is being developed further in clinical studies. It is presumed that chemotherapy and radiotherapy are rendered more effective when a tumor is overheated. The result can be an improved quality of life, halting of the disease, or even a complete cure. As a Top Oncological Center, the interdisciplinary cancer facility is supported by German Cancer Aid as a Charité Comprehensive Cancer Center (CCCC). We are committed to fulfilling the high standards which this represents.

We use the most modern methods to treat our patients. We are, however, driving forward our research efforts in order to further improve existing standardized treatment methods and thus increase the chances of a cure and reduce side effects. Moreover, we combine these methods depending on the actual cancer and tailor them to our patients.

Hyperthermia is performed in close cooperation between the Department of Radiation Oncology and Radiotherapy (Dir.: Prof. Dr. med. Dr. h.c. Volker Budach) and the Department of Pediatrics, Division of Oncology and Hematology (Dir.: Prof. Dr. Angelika Eggert).

Kind regards,

Volker Budach, MD, PhD
Chair of the Dept. of Radiation Oncology and Radiotherapy
Campus Virchow-Klinikum

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Hyperthermia: Method

What does hyperthermia treatment involve?
The word hyperthermia is derived from Greek and means overheating. With hyperthermia treatment, the tumor area is heated to a temperature of up to 43°C (109°F) for around an hour.

How does hyperthermia work?
It has been known for some time that cancer cells are more sensitive to heat than healthy cells. As such, just the process of heating them up causes some of the tumor cells to die. In addition, so-called heat shock proteins form in the tumor tissue. These proteins tell the immune system that cancer cells have formed. The body’s own defense system can now react and send killer cells to attack the tumor. A further positive effect of overheating is an improvement in the blood circulation and thus also the oxygen supply within the tumor. This, in turn, serves to improve the effectiveness of chemotherapy and radiotherapy. For this reason, we never use hyperthermia on its own in our department, but rather only ever in combination with one or both of the standard treatments mentioned.

What role does temperature measurement play?
Temperature measurement is vital in order to perform the treatment in a controlled manner. Temperatures between around 42°C and 43°C (108°F - 109°F) are ideal. This limit may only be exceeded in the tumor and not in the surrounding healthy tissue as this can otherwise be damaged. In Berlin we use the classic method of high-precision temperature measurement with high-resistance temperature sensors (thermistors) in the tumor and normal tissue.

What types of hyperthermia are used at the university department of radiation oncology?
We use regional deep hyperthermia for deep-seated tumors and large tumors in the abdomen, pelvis and limbs. Patients are positioned in a so-called ring applicator with several integrated antennae which radiate high-frequency electromagnetic waves. The antennae are arranged in a ring shape and controlled separately via a multi-channel amplifier system using special software. In this way, the waves are focused directly on the tumor area to be heated for the purpose of hyperthermia.

Local superficial hyperthermia is used for tumors which are just under the skin.

Hyperthermia: Applications

For which children and adolescents is hyperthermia an option?
In the Department of Pediatrics, Division of Oncology and Hematology at the Charité, Campus Virchow-Klinikum, hyperthermia is used in combination with chemotherapy or radiotherapy for the following tumor types after an assessment.

- Germ cell tumors
- Neuroblastomas
- Sarcomas/soft tissue sarcomas
- Ewing’s sarcoma
- Retroperitoneal tumors or solitary metastases with a controlled primary tumor
- Abdominal tumors or solitary metastases with a controlled primary tumor
- Paraspinal sarcomas
- Limb tumors
- Non-resectable local recurrences or solitary metastases

When must hyperthermia not be performed?
Absolute contraindications are metal implants such as prostheses and stents because, under certain circumstances, they can become very hot and result in burns and necrosis. Moreover, hyperthermia treatment should not be performed on patients with serious heart conditions, as the application of heat can put a strain on the cardiovascular system.

We only perform hyperthermia in combination with radio- and/or chemotherapy. Furthermore, hyperthermia is only performed within the framework of clinical studies.
Hyperthermia: Treatment

How is hyperthermia treatment performed?
In preparation for hyperthermia, the first step is to calculate the temperature distribution. In order to tailor treatment to the child or adolescent, in our department we use various computer-aided planning systems, including Sigma-Hyperplan. On the basis of this planning, the tumor can be heated precisely, while ensuring maximum protection for the healthy tissue. Before treatment begins, measuring probes are positioned as close as possible to the cancer focus in order to measure the temperature during treatment. The temperature in tumors which are located directly under the skin can be established by measuring the temperature on the skin surface. For cancer foci in the interior of the body, we use natural body orifices such as the rectum, urethra and vagina. In some cases it may prove necessary to insert an invasive probe under local anesthesia. Following this preparatory phase, the child/adolescent is positioned in a ring applicator for regional deep hyperthermia. Antennae located inside the applicator radiate electromagnetic waves and thus generate heat in the body in a similar way to a microwave oven. We use the modern system BSD 2000 3D with a series of ring applicators (SIGMA-Eye, SIGMA-60, SIGMA-40, SIGMA-30). This allows us to offer the ideal treatment for all patients, from adults through to infants. Actual hyperthermia commences after a heating-up period of approx. 30 minutes and takes around one hour. The accompanying chemo-/radiotherapy must follow immediately before or afterwards.

Are children on their own during treatment?
No. Children and adolescents may be accompanied by their parents at all times. And, of course, they are cared for continuously by our expert team: A medical physics expert permanently monitors the adequate temperature and the technical parameters in the control room. Our medical and nursing staff watch over the cardiovascular state of the children and adolescents and ensure their well-being. They are monitored via a large lattice window and contact can be made with them directly. On request children can listen to music or watch a film during treatment.

Depending on their age, some children are unable to lie still during treatment. In such cases, we can administer a sedative or anesthetic.

At what intervals is hyperthermia administered?
This depends on the specific diagnosis. In general at the Charité hyperthermia is performed once or twice a week during oncological treatment (radio- and/or chemotherapy).

Are there any side effects of hyperthermia?
In most cases no significant side effects are experienced. Reddening of the skin due to overheating and water retention in the tissue are seen in rare cases. Necrosis of fat tissue, which normally heals without any complications, is even more seldom. With pelvic and abdominal tumors, the pressure from the water bag attached around the patient may be unpleasant. However, this sensation of pressure disappears immediately after treatment.
Hyperthermia: Quality assurance

What quality criteria are applied to hyperthermia at the Charité?

Treatment is performed based on the quality requirements and guidelines of the European Society for Hyperthermic Oncology (ESHO) and the Interdisciplinary Hyperthermia Working Group (IAH) of the German Cancer Society (DKG). Our expert hyperthermia team comprises trained medical staff, medical physics experts/engineers, nursing staff and medical technical assistants with many years of experience in the field of hyperthermia. At our university department the high quality requirements specified by the exacting hyperthermia procedure are met in full. For example, the recording of all relevant treatment parameters is computer-controlled and the accuracy of the temperature display is checked daily. Furthermore, a large number of hyperthermia treatments are documented and evaluated within the framework of clinical studies.

What does the research say about hyperthermia?

Important international and national studies with control groups have confirmed the efficacy of hyperthermia in combination with radio- and/or chemotherapy for tumors in adults with, in part, results showing impressive tumor regression. In other cases, the use of hyperthermia allowed the patient’s life to be extended (compared to patients who received standard therapy without hyperthermia). Far less clinical data is available for children. The data, however, does indicate very good tolerance and efficacy among children as well. Nevertheless, further research on hyperthermia is required, particularly among children, adolescents and young adults.

Where can you find more detailed information on hyperthermia?

You can find reliable information online from the following institutions:

- Department of Pediatrics, Division of Oncology and Hematology
  http://paedonko.charite.de/klinik/bereiche/hyperthermie
- Interdisciplinary Hyperthermia Working Group (IAH)
  www.hyperthermie.org
- Society for Paediatric Oncology and Haematology
  http://www.kinderkrebsinfo.de/hyperthermie
How to find our department:

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