THE CNAO FACILITY FOR HADRONTHERAPY
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On November 13th 2012, the first patient affected by a salivary gland carcinoma has been treated with carbon ions at the CNAO facility in Pavia. The CNAO (Italian acronym that stands for National Centre for Oncological Hadrontherapy) has been realized in Pavia, Italy. It is a clinical facility created and financed by the Italian Ministry of Health. CNAO mission is twofold: on the one hand, treating patients with solid tumours by using protons and carbon ions, particles called hadrons (hence hadrontherapy); on the other hand, developing clinical, radiobiological and translational research.

This is an important innovation on the front of the fight against cancer and a concrete hope for thousands of patients, to traditional therapy has not given the desired results. Hadrons are characterized by a maximum of energy deposition at the end of their range and a sharp penumbra that allow to achieve a precise coverage of the target and an enhanced sparing of the surrounding healthy tissues. In addition, carbon ions, as for the type of damage they can provoke to the tumour mass, are responsible of a much more intense efficacy, suitable for the treatment of radioresistant tumours.

CNAO started treating patients with proton beams in September 2011, and so far almost 60 patients have been treated with protons in the framework of different clinical trials. CNAO is the second centre in Europe to provide such ion beams for cancer treatment, after the Heidelberg Ion-Beam Therapy Centre (HIT) began clinical trials in 2009.

The treatment of patients with carbon ions has been approved in July 2012 by the Italian Ministry of Health after a detailed review of the data presented by CNAO on dosimetry and radiobiology, both in-vitro and in-vivo. These experimental activities have been performed in the first part of 2012 also thanks to the collaboration of the Italian Institute of Nuclear Physics (INFN) and the Japanese National Institute of Radiological Sciences (NIRS). The data presented at the National Health Council confirmed the expected beam parameters specifications and also demonstrated the high standards of safety and quality reached at CNAO.

The first months of 2012 were also important to adopt a quality management of the CNAO procedures and on July 17th the certifications ISO9001 and ISO13485 have been obtained. This is a fundamental step in view of the CE marking of CNAO. In fact, the CE marking of the different clinical protocols is mandatory to start the routine hadrontherapy treatments.

The realization of CNAO is based on a strong collaboration network: the CNAO Collaboration that links CNAO with the most important Institutions in Italy and abroad. In particular for the high technology, INFN contributed to the completion of 15 tasks and shared the co-direction ship of the realisation. This network (presented in detail on the website of CNAO: www.cnao.it) has guaranteed through the years, and it will be the case also in the future, the collaboration of outstanding personalities and expertises to the programmes of the CNAO Foundation. In addition it has been a fundamental mean of formation for the people of CNAO who have gained unique expertise in Italy and also in the World through the years.

In the World there are almost 50 centres that are treating patients with protons and more than 90,000 patients affected by various pathologies have been treated so far. Six centres are active with carbon ions and, besides CNAO and HIT, there are three centres in Japan and one in China, also
one centre in Europe and one in China are in construction. Still at European level, there are almost a
dozen projects, coordinated within the framework of ENLIGHT (European Network for Light Ion
Therapy), trying to obtain approvals and funding. Within the Seventh Framework Programme of the
European Community, CNAO participates in two projects already approved and funded. The
project ULICE (Union of Light Ion Centres in Europe), in which CNAO coordinates twenty
European institutes to “open” hadrontherapy Centres to the international clinical and scientific
community and to support research, training and communication projects. The second project,
named PARTNER, brings together a dozen institutes with the aim of forming a new generation of
health professionals and technicians in hadrontherapy activities. Recently also US Agencies have
shown interest in hadrontherapy with light ions and they look with attention to the experience of
Japan and Italy.

CNAO’s main objective of 2013 will be the increase of the patients throughput and the approval of
most of the ongoing clinical trials. At the beginning of the year the third treatment room will
become operational and it will add one horizontal and one vertical beamlines to the already active
treatment rooms (two rooms with one horizontal beam each). The photo below shows the inside of a
treatment room. In the foreground are shown the systems used for the patient positioning and the
verification of the correct alignment with the beam port.

Of the more than 120,000 Italian patients treated each year with radiotherapy, it is estimated that
about 5 percent of cases can be treated with hadron beams. Hadrontherapy can be used in the
treatment of sarcomas, paediatric tumours, cancer of the lung, pancreas, liver, prostate, eye, salivary
gland, brain, spinal cord and on certain head or pelvic area cancers.

At full capacity the Centre will provide Hadrontherapy treatments, 5 days a week for 13 hours a day
to about 2,000 out-patients a year, with about 20,000 sessions being performed annually in the three
treatment rooms with four beam lines. An experimental room dedicated to radiobiological and
clinical research will also be available.