

## A project to establish a network of international centres

# CENTRES FOR TREATMENT, RESEARCH, EDUCATION AND PREVENTION FOR TRAUMATIC BRAIN INJURIES

### Background

Traumatic brain injury (TBI) is a brain damage caused by an external force (strike, deceleration). The most important causes are falls and road traffic injuries, followed by violence and sports injuries.

In Finland, approximately 35 000 persons suffer a TBI every year. Of these, about 1150 die and about 10 000 will be left with a permanent impairment. Half of the injured victims are under 35 years of age. In Finland, the yearly TBI mortality is twice as high as in all other Nordic countries. TBI is the most usual immediate cause of death in young people and adults of working age, and causes more deaths in the age-group < 35 yrs than all diseases put together. The annual costs of TBI are at least two billion € in Finland. A severe permanent disability of a young person costs the society € 1.36 million, and death € 2.43 million.

According to WHO predictions, road traffic injuries will be the third most important health burden in the world in the near future, and TBI is the most common cause of death and permanent disability in these injuries. However, falls are an even more common cause of TBI. According to WHO statistics, in Europe, about 125 000 persons die of TBI every year, which makes it a more common cause of death than, e.g. all dementias put together. About one million Europeans annually suffer a TBI which causes permanent disability. The significance of TBIs is also highlighted because they promote the aging phenomena of the brain, hastening, e.g. the manifestation of Alzheimer's disease by several years. No other disease or injury causes even nearly as much lost healthy years as TBIs. Indeed, already over ten years ago, the management of acute TBIs was found to be one of the most cost-efficient areas in medicine.

TBIs have been called the most neglected area in medicine, especially considering their significance. Within the EU, we do not have a single multidisciplinary centre which concentrates solely on TBI care and research. Not a single drug has been developed or registered to treat TBI. In Finland, we have only one active multidisciplinary TBI research team and only a handful of clinical specialists. This could be compared to the situation where we would have only one group doing cancer research and only a few clinicians familiar with treating cancer. The situation is similar or even worse in many other European countries.

The care of TBI patients is very variable also in the western countries. Tens of percents of cases remain undiagnosed in the acute phase, and thus also without treatment. Reliable methods to estimate the severity of TBIs or even to detect them are lacking, and many essential clinical questions have not been clarified. Teaching and research on TBI have been very modest, because TBIs have not been clearly the responsibility of any one specialty. Accordingly, many fundamental aspects are poorly known, both among physicians and the general public. One speaks of the so-called Hollywood myth: a blow to the head and after a short period of unconsciousness the action goes on, as if nothing had happened. However, the medical reality of TBIs is usually very different.

Especially poorly known are the TBIs in children, where significant research and knowledge are lacking throughout Europe. Long-term follow-up studies have in many ways questioned the former concept of good recovery from TBI in children. TBIs in childhood have a negative influence on the intellectual and psychosocial development. The developmental stage of the brain during the injury is apparently crucial, but very little is known about this field.

## Why special centres are needed?

TBIs require multidisciplinary teamwork, where experts from several specialties work in close collaboration. Because of the strong borders between different specialties in traditional medicine, the lack of this kind of concept has resulted in TBIs remaining wholly in-between. As they are considered to be traumas, TBIs have been under the primary responsibility of (neuro-)surgery, although less than 2 % of TBIs require surgical intervention. Indeed, the clinical care of TBI victims requires, in addition to neurosurgery, also neurology, anesthesiology and critical care, psychiatry, physical medicine, neuropsychology, neurophysiology, diagnostic imaging, and clinical chemistry. Moreover, many TBI patients also have other injuries, which require attention, e.g. from a trauma surgeon, otorhinolaryngologist, dentist or ophthalmologist. In the scientific research of TBI, neurochemistry, neuropathology, neuropharmacology, molecular biology, neuroimmunology, and biomechanics are also needed. Naturally, the same requirement of multidisciplinary expertise holds true for TBIs in children.

Real progress in TBI care requires centres, where experts from the above-mentioned specialties together study the mechanisms of brain injury, protection, and recovery. In addition, this brain research has to be connected to a comprehensive and individual approach, which takes into consideration, e.g. the effects of personality, social environment and psychological factors in recovery. This is because TBI overturns the psychosocial well-being of an individual possibly more than any other illness or injury. Here too, the chain is as weak as its weakest link, and effective care of TBI requires the optimization of numerous stages from the injury scene to the post-injury rehabilitation that may last for years. Also in case of TBIs, prevention is the optimal care, and promoting this requires continuous epidemiological follow-up of the causes and incidence of TBI.

## Strategy

The ultimate goal of all measures within the planned centre network is to diminish the mortality, disability, suffering and costs caused by TBIs. This goal will be reached by combining in each centre the various experts into a determined team, which through high-class care and research and comprehensive education will promote this objective. These teams would consist of both domestic and foreign experts. In order to create effective networks, the foreign researchers will preferably be recruited from the most important foreign collaborating centres. As a wholly new concept in medicine, the centres will take national and partly also international responsibility for continuous progress in the level of care and know-how of TBI and its prevention.

The **research** strategy is to create sufficiently equipped centres to study the mechanisms of injury, protection and recovery of the brain. These centres would have wide national and international contacts within both basic and clinical research. The own research activity of the centres will concentrate on clinical research, especially on clinical applications of basic research, development of new treatments and progress in diagnostics. Clinical research is particularly important because TBIs affect most the brain functions which are characteristic for humans. In addition, essential fields of research will be the epidemiology and biomechanics of TBI, which will serve as a scientific basis for TBI prevention.

Within **clinical care**, the strategy of the centres is to develop superior multidisciplinary clinical expertise through continuous development of the whole treatment process, efficient internal education, continuous learning, an international expert network, clinical research, and continuous monitoring of treatment outcome. The aim of the centres is to be, in TBI care, pioneers, which will be visited by professionals all over the world in order to learn the best possible care of TBI patients.

The strategy in **teaching and education** is to create a course of action, in which these national and international units take the responsibility to promote the implementation of best clinical practice in their home countries and also in neighbouring countries, through regular audit and education systems. This mode of action guarantees the transmission of the best medical know-how to all quarters where TBI patients are taken care of, and controls the carrying out of optimal care also in

practice. International education will be carried out by directing the audit especially to the new member states of the EU, by keeping up an active exchange of researchers, by offering consultations to developing countries through the Internet, and by keeping up a continuously updated data bank of TBI care. The international education will be carried out using the "chain letter principle", where a target unit from the fellow country will be supported by long-term education and audit, as well as by helping this unit to act as a unit responsible for the progress of care within its own country. The efficiency of the education will be followed by monitoring the changes in epidemiology and outcome of TBI in target areas by independent partners. This mode of action could have wider applications in medicine, in promoting the quality of care and diminishing regional inequality. In this way, the centres act as a new way to search for efficiency in health care.

Within TBI **prevention**, the centres will act initiatively and actively as a 'motor' with several different partners. The scientific basis of prevention will be the scientific and experimental knowledge of the consequences of TBI, and especially the continuous epidemiological follow-up, by means of which the prevention can be targeted efficiently.

### **Why has this project started in Turku?**

In Turku, we have a long tradition within several main areas of neuroscience. The only multidisciplinary study group doing active and long-term TBI research in Finland has been in Turku for over ten years. Scientists in Turku are nowadays studying the inflammatory mechanisms of nerve injury, interneuronal communication, mechanisms of learning, mechanisms of consciousness, and cortical transmitters. These are all essential questions also in regard to TBI. In Turku, we have many centres which allow mutually beneficial co-operation (e.g. the national PET centre, the Centre for Cognitive Neuroscience, BioCity, the Clinical Research Centre, the Centre for Disease Modelling). In Turku, we have exceptionally good possibilities to develop, e.g. new pharmacological tools to treat TBI, because of the strong biomedical and pharmacological expertise and the PET centre. The centre is a natural step in the continuum of biomedical investments made by the university, companies and the province in the Turku district, and the first centre that concentrates on clinical work and study. Considering its geographical situation and traffic connections, it may be easier to recruit international scientists to Turku than to many other areas in Finland.

The Health District of South-Western Finland has chosen functional neuroscience as one of its target areas, and is strongly promoting this project. It is also supported by the University of Turku, the City of Turku, and the Union of South-Western Finland, as well as clinicians and scientists in the region. This project has been planned so that the centre will provide synergy for several study groups, clinics and specialties, both locally and nationally. An international centre, which even in a global perspective would work as pioneer in the field of a severe health problem, would bring international visibility, scientific collaboration, international education and economical benefits both locally and nationally.

### **The goal for resources**

The clinical work of the Turku centre will be integrated with clinical care of the new T-hospital of the Turku University Central Hospital, starting in 2011. All emergency medicine in the Turku region will be concentrated in this hospital. The expertise of the centre stems from investments in the personnel and its continuous education, and from the fact that the clinical scientists who are responsible for the patient care in the centre, can fully concentrate on TBI research and care.

A long-term goal for the resources of all centres is to acquire 15 to 20 clinical scientists (who will participate in patient care) and 15 to 20 other neuroscientists. In addition, the centres will need modern imaging, neurophysiological, biochemical and neuropathological laboratory facilities, which will mainly be obtained either through joint ownership with the closest collaborating partners, or by using the already existing resources. With the above mentioned resources, these centres

could act as internationally leading centres for TBI research, care and education, and to promote global health within a very important medical area.

## **Financing and timetable**

For the resources described above, the annual budget for one centre has been calculated to be € 5 – 6 million. This sum can be compared with the fact that prevention of permanent disability of four young persons or the death of two young persons per year covers these annual costs. Among possible international financiers are the EU, insurance companies, international foundations, drug companies and other companies (e.g. car companies), and among possible national financiers the Ministry of Social Work and Health, national foundations, the local health district, the university, the city of Turku, the Ministry of Education, and the Finnish Academy.

For the Turku centre the goal is to establish the founding contract and the financing contracts during the year 2010. This centre could start its education and research activities during the years 2010 – 2011, and aim for full activity with the obtained resources during the year 2012. The goal is to finance the founding and activity during the first four to five years through project financing, and during this time to show the efficiency and cost-efficiency of the centre's activities to those financiers who would cover the maintenance costs in the long term.

During the years 2010 – 2011, the Turku project will have negotiations with the TBI research groups in Europe, in order to make an agreement, which groups are willing to develop themselves as centres, acting along the above-mentioned principles. For this network of centres, the goal is to establish the founding contracts till the end of 2012 and to start activity in all centres by the end of 2013.

## **Organization of the Turku project**

Advisory board: vice-chancellor Matti Viljanen (TU), vice-dean Markku Koulu (TU), prof. emer. Jouko Suonpää (TU), prof. Kari Majamaa (OU, neurology), prof. Juha Öhman (TaU, neurosurgery), prof. Heikki Hämäläinen (TU, psychology), prof. Lennart von Wendt (HU, child neurology), chief physician Esa Kotilainen (TU, neurosurgery), chief physician Jaakko Rinne (KU, neurosurgery), development chief Satu Suhonen (health district).

Project group: project leader Heikki Korvenranta (T-hospital project), department chief Juha Perttilä (TUCH, critical care), chief nurse Tiina Pakasto (TUCH, surgery), personnel lawyer Tom Riski (health district), research representative Jari-Pekka Tuominen (health district), project coordinator Päivi Salonen (health district).

Project leader: dos. Olli Tenovuo (TU + TUCH, neurology), project assistants Dr. Janek Frantzén (TUCH neurosurgery) and Dr. Ari Katila (TUCH neuroanaesthesiology).

Project chief: chief physician Turkka Tunturi (TUCH).