

Department of Neurosurgery

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General Summary

The research studies in our department, examining such topics as syringomyelia, endovascular surgery, mechanism of head injury, and pediatric neurosurgery, made good progress during the past year. Research in these areas was performed to international standards. Clinical research on brain tumors, hypothalamic disorders, and spine and spinal cord diseases has also continued.

Research Activities

Cerebrovascular diseases · Endovascular surgeries

1. Analysis on the natural history of unruptured intracranial aneurysms.

Since 2003, more than 3,000 intracranial aneurysm patients have been visited our department. As a leading aneurysm treatment center in the world, we have placed a great value on a precise real-time data base of the aneurysms patients.

We focused on the analysis of 1) natural history of the unruptured aneurysms, 2) risk factors associated with the rupture of aneurysms, and 3) risk factors associated with treatment.

2. Analysis of fluid dynamics of human intracranial aneurysms using a computational fluid dynamics (CFD) models.

The main topics of our current study include 1) development of novel parameters, 2) elucidation of relationships between the hemodynamic patterns and rupture risk, 3) Development of a novel CFD software dedicated to the image workstation for angiographic equipment.

3. Development of a novel intracranial stent device for the treatment of brain aneurysms.

A novel intracranial stent device for the treatment of brain aneurysm is currently under development.

A preclinical animal study is ongoing. This project is supported by the Ministry of Economy, Trade and Industry under a research grant. We are now in the final stage of consecutive experiments, and the results will be reported to the Ministry of Economy, Trade and Industry in 2017.

4. Establishment of a tele-medicine network utilizing a novel software for smartphones. Recently tele-medicine software “Join” became available for any smartphone users. The application allows every medical staff to have instant access to the PACS system of the Jikei university hospital, and allows each member to communicate using an online bulletin board system. The application is released in the collaboration with NTT Docomo, which is the Japan’s largest mobile service provider, serving more than 60 million customers

Brain tumor

1. Immunotherapy of malignant glioma

Effective antigen presentation to T cell subsets, such as CD8+ and CD4+ T cells, is a critical step in the generation and maintenance of immune responses against cancer cells. Although several cell types have the ability to present antigen, this function is performed most efficiently by professional antigen presenting cells, of which dendritic cells (DC) are the most potent. After exposure to tumor-associated antigens (TAA), DCs process and express TAA-derived epitopes in combination with MHC class I and II molecules on their cell surface, which induce TAA-specific cytotoxic T-lymphocyte (CTL) and T-helper type 1 (Th1) subsets, respectively. We had earlier shown that immunotherapy with fusion cells (FC) of DCs and glioma cells induces safe, tumor specific immune responses in glioma patients. In the recent study, we observed that Poly(I:C) transfected FCs induced high levels of endogenous IL-12 secretion from FCs. We also found that the ability of Poly(I:C)-transfected FCs to produce IL-12 was preserved when endogenous IL-10 was suppressed by small interference RNA (siRNA) of IL-10 (IL-10-siRNA) and that FCs cotransfected with IL-10-siRNA and Poly(I:C) elicited an efficient tumor-specific Th1 response. We started a clinical trial of “Immunotherapy with fusions of glioma cells, glioma initiating cells, and DCs”.

2. Study of intra operative imaging using C-arm CT

We use a C-arm CT, syngo DynaCT system (SIEMENS), as well as an image analyzing soft wear for metal-artifact reduction in surgical resection of brain tumors. An intra operative imaging by this system improves the resection ratio of tumors, together with a surgical navigation system and a photo-dynamic diagnosis by 5-ALA. This study is aimed at optimizing safe technical innovations in surgery of brain tumors.

Neurotrauma

Few institutions have performed research in neurotraumatology. A unique aspect of our department is that we have undertaken 3 major studies in this area of research. We examined the prevalence of sports-related head injury in collaboration with the Japan Society of Clinical Sports Medicine and the Japan Society of Neurotraumatology. We have also examined sports-related concussion and performed mechanical studies of head injury through simulations.

Spine and Syringomyelia

About 50 patients with syringomyelia are treated surgically in our department each year. By evaluating cerebrospinal fluid (CSF) obstruction at the craniovertebral junction in

patients with syringomyelia related to Chiari malformation, the relation between CSF circulation blockage and cavitation of the spinal cord has been clarified. Therefore, improving the CSF circulation becomes the goal of surgical treatment. However, the mechanism of cavitation of the spinal cord itself is not fully understood. In patients with Chiari malformation, the cerebellar tonsils and the ventral vector (i.e., dens) compress the spinal cord and restrict CSF circulation. We examined whether these 2 factors influence the effects of foramen magnum decompression.

Division of Pediatric Neurosurgery

Division of pediatric neurosurgery conduct operations for patients with spina-bifida such as myeloschisis and spinal lipoma, hydrocephalus caused by various medical conditions, cranial facial anomaly, and brain tumor, etc., and follows them postoperatively at the outpatient clinic. There have been more than 1,700 new cases in various entities over the 10 years. We currently consist of a consultant, a division staff, and a resident, promoting clinical research through various clinical activities.

As for spina-bifida, we are currently examining the prognosis of neurological functions by operating under neuro-monitoring. We are also developing operative procedures for hydrocephalus using neuroendoscope, with the application of navigation systems.

Publications

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