

## 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 in the past year. Research in these areas is 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 patients with intracranial aneurysms have visited our department. As one of the world's leading aneurysm treatment centers, The Jikei University has placed a great value on establishing a precise real-time database of patients with aneurysms.

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

##### 2. Analysis of biofluid mechanics on human intracranial aneurysms using a computational fluid dynamics

The main topics of our current studies include: 1) development of novel variables, 2) clarifying the relationship between hemodynamic patterns and the risk of rupture, and 3) development of dedicated software for computational fluid dynamics for angiography workstations.

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

A novel intracranial stent device for treating brain aneurysms is being developed.

A preclinical animal study is in progress. This project is supported by a research grant from 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 2016.

4. Establishment of a telemedicine network utilizing a novel software for smartphones  
Recently “Join,” the next generation of telemedicine software, is available for any smartphone user. The application allows all medical staff to have instant access to the picture archiving and communication system in The Jikei University Hospital and allows the staff to communicate with an online bulletin board system. The application has been released in collaboration with NTT Docomo, which is Japan’s largest mobile service provider, with more than 60 million customers.

#### *Brain tumor*

##### 1. Immunotherapy against 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 antigens, this function is performed most efficiently by professional antigen-presenting cells, of which dendritic cells (DCs) are the most potent.

After exposure to tumor-associated antigens (TAAs), DCs process and express TAA-derived epitopes in combination with MHC class I and II molecules on their cell surfaces and induce TAA-specific cytotoxic T-lymphocyte and T-helper type 1 subsets, respectively. We have previously shown that immunotherapy for glioma with fusions of DCs and glioma cells induces safe, tumor-specific immune responses. In a recent study, we observed that polyinosinic:polycytidylic acid (Poly[I:C]) transfection induced high levels of interleukin (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 T-helper type 1 response. At the 73<sup>rd</sup> annual meeting of the Japan Neurosurgical Society and the 32<sup>st</sup> annual meeting of the Japan Society for Neuro-Oncology.

##### 2. Study of intraoperative imaging with C-arm CT-

We use a C-arm CT, *syngo* DynaCT system (Siemens Medical Systems), and an image-analysis software program for metal-artifact reduction in the surgical resection of brain tumors. Intraoperative imaging with this system helps increase the resection rate of tumors with a surgical navigation system and photodynamic diagnosis with 5-aminolevulinic acid. The purpose of this study is to establish safe technical innovations for the surgical resection 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 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*

The Division of Pediatric Neurosurgery performs operations for patients with spina bifida, myeloschisis, spinal lipoma, hydrocephalus caused by various medical conditions, cranial facial anomaly, and brain tumor and follows them up postoperatively at the outpatient clinic. In the last 10 years we have treated more than 1,700 new cases of various entities. We currently consist of a consultant, a division staff, and a resident and promote clinical research through various clinical activities.

For spina bifida, we are currently examining the prognosis of neurological functions by operating under neuromonitoring. We are also developing operative procedures for hydrocephalus using neuroendoscope and proposing the usage of navigation systems.

### **Publications**

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