Dec. 15, Room A

Invited lecture: Neurofluid: a new concept of the CNS fluid dynamics

New mechanisms for the efflux of neurofluids and neurometabolites: key relationships between the functions of meningeal lymphatic vessels and extravascular fluid pathways

Masahiro Miura

Department of Anatomy, Faculty of Medicine, Oita University, Japan

Although produced through different mechanisms, both cerebrospinal fluid and cerebral interstitial fluid have recently been called “neurofluids,” as they are both neurally related fluid components that move freely. These neurofluids are primarily produced in the intracerebral microvascular network and the ventricular choroid plexus, but understanding the pathophysiology of cerebrospinal fluid (CSF) abnormalities, such as leaks and drainage issues, requires a detailed description of neurofluid production and absorption mechanisms, which is still largely unknown. The brain region is an organ system in which lymphatic vessels are not developed. As a result, neurofluids are considered to compensate at the main drainage system of the upstream efflux pathways for the glymphatic clearance system connecting perivascular spaces and intramural periarterial drainage, with the exception of reabsorption through brain microvascular networks. For the downstream efflux pathways of both systems, the 2015 discovery of the meningeal lymphatic vessel as a new efflux pathway has caused some reconsideration of efflux pathways to the deep cervical lymph nodes. However, the changing mechanism by which the downstream efflux pathway drains extracranially into the general somatic lymphatic system is still unknown.

The classical absorption pathway from the cribriform plate through the lymphatic system of the nose mucosae was thought to be an active CSF absorption pathway that is unique to rodents and inactive in humans. On the one hand, the new absorption pathway of CSF draining into the ocular lymphatic system via the optic nerve sheath is fascinating. On the other hand, in the spinal cord region, the absorption system mediated by the epidural lymphatic network (EDLN) is considered to be in charge of CSF pressure regulation. Its operation depends on the link that it forms with the pre-lymphatic channel (PLC) on the most inner surface of the spinal nerve root sheath (Miura et al, 1998). As a leak into the spinal root sheath through the PLC is generally a physiological phenomenon, that area is interpreted to be a subarachnoid space in the broad sense of the word and a physiological reservoir [magnetic resonance imaging (MRI - teardrop sign)] for CSF. That being said, water balance in the central nervous system is also closely related to postnatal development and age-related regression of the meningeal lymphatic network (MLN) and EDLN, which are linked to the meningeal related PLC.

In this presentation, we will reconsider the latest neurofluid discharge pathways (nine varieties) based on our experimental findings and describe the histochemical characteristics of meningeal lymphatic networks, a key component in the lymphatic absorption pathway for neurofluids (CSF tracer injection experiments, MRI analysis, etc.). Furthermore, we will describe the structural features of the meningeal PLC, a physiological guidance pathway to the MLN, in humans.

This study was approved by the Ethics Committees of the Faculty of medicine, Oita University (approval No.2014-716 and 2020-1979). (COI:NO)

ACADEMIC EDUCATION:

1980-1984	B.S. Health science, University of Tsukuba, Faculty of Health science and Physical education (Neurophysiology), Tsukuba, Japan
1984-1986	M.S. Neurophysiology, University of Tsukuba, Graduate school of Comprehensive Human Sciences, Master's Program in Health Science and Sports Medicine, Tsukuba, Japan National Institute of Advanced Industrial Science and Technology (AIST), Health and Medical Research Institute (graduate student)
1994	Ph.D Neuroanatomy, Oita Medical University. Faculty of Medicine: No.64
2003	MHLW-accredited cadaveric autopsy qualifications (License): No.7719

PROFESSIONAL ACTIVITIES:

1986 1989	Assistant professor in the Department of Anatomy and Life Structure, University of Juntendo, Faculty of Medicine, Tokyo
1989-1996	Assistant professor in the Department of Anatomy (I) Faculty of Medicine, Oita Medical University, Oita
1996-2005	Lecturer in the Department of Anatomy (I), Faculty of Medicine, Oita Medical University, Oita
2005-present	Senior Lecturer in the Division of Morphological Analysis, Department of Anatomy, Biology and Medicine, Faculty of Medicine, Oita University, Oita
(1997-1998)	Institut für Anatomie und Zellbiologie, Medizinische Fakultät Julius-Maximilians-Universität Würzburg, Würzburg, Germany (Visiting scientist) (Head: Prof. Dr. M.v. Lüdinghausen)
(2001)	Division of Anatomy and Histology, Department of Basic Sciences, Faculty of Dental Sciences University of Peradeniya, Peradeniya, Sri Lanka (JAICA educational support)

MEMBERSHIP OF MAIN ACADEMIC SOCIETIES:

Japanese Society of iNPH
Japanese Association of Anatomists (Board member)
Japanese Society of Lymphology
Japanese Cancer Association
American Association of Clinical Anatomists (AACA)
Japanese Society for Lymphedema Therapy

HONRS AND AWARDS:

1. Young Investigator Award of the British Association of Clinical Anatomists 1997 (Glasgow, England)
2. Academic NISHI Award of the Japanese Society of Lymphology 2009 (Osaka)
3. Japanese Traveling fellowship (Japanese Association of Anatomists) 2010, 2019 (Iwate & Niigata)
4. Best Research & Presentation Award of the Japanese Society of Anesthesiologists 2013 (Sapporo)
5. Best Poster Award of the Japanese Society for Lymphedema Therapy 2019 (Tokushima)
6. Best Presentation Award of the Japanese Society of regional Anesthesia 2018, 2019 (Kochi & Matsumoto)
7. Best Paper Award of the Kyushu･Yamaguchi Society of Sports Medicine 2019 (Fukuoka)

Dec. 15, Room A
Invited lecture: Neurofluid: a new concept of the CNS fluid dynamics

Neurofluid (clinical): pediatric posttraumatic low ICP syndrome

Koichi Takahashi
Department of Neurosurgery, Sannou Hospital

Dec. 15, Room A

Special session: Controversies in surgical management of pediatric brain tumors

2: Convection Enhanced Delivery in Diffuse Intrinsic Pontine Glioma (DIPG): does it the way to go?

Answer

Ryuta Saito

Department of Neurosurgery, Nagoya University

Dec. 15, Room C

Educational session 4: From basic to advanced management—surgery for syndromic, complex craniosynostosis

How to surgically treat complex craniosynostosis?

Ikkei Tamada, MD, PhD

Department of Plastic and Reconstructive Surgery, Tokyo Metropolitan Children's Medical Center

In the comprehensive treatment of craniosynostosis, a multidisciplinary team approach grounded in protocol is mandatory. On the other hand, the protocol of each institution can be influenced by new concepts. In the past two decades, posterior cranial vault distraction, suturectomy with postoperative helmet therapy, and spring-assisted cranioplasty have changed global trends in craniosynostosis management.

Tokyo Metropolitan Children's Medical Center's craniofacial team began their operations in 2010. After some changes were made to the institutional protocol, 52 patients with complex craniosynostosis comprising 17 cases of major craniosynostosis syndrome (Crouzon, Apert, and Pfeiffer syndrome), seven of miscellaneous syndromes, eight of bicoronal synostosis of unknown etiology, 14 of bilambdoid and sagittal synostosis, and six of other forms of multiple synostosis were surgically treated between January 2011 and September 2023.

As above mentioned, each craniosynostosis case is treated in accordance with the institutional protocol, using an algorithm for practical decision making. In particular, the type of cranioplasty for syndromic craniosynostosis is determined by taking into consideration age at surgery, degree of proptosis, occipital region shape, suture condition, and skull thickness. The institutional protocol involves three, basic, surgical techniques i.e., fronto-orbital advancement, posterior cranial vault distraction, and strip craniectomy with postoperative helmet therapy. If the patient presents severe proptosis, early fronto-orbital advancement with or without distraction osteogenesis is considered. Then, if the patient is aged <6 months the strip craniectomy with postoperative helmet therapy is considered. This procedure helps to achieve the natural, round shape of the head and adequate cranial bone thickness, enabling subsequent treatments to be performed on a more secure footing. Usually, posterior cranial vault distraction is considered after confirming that the bone status of the posterior region can withstand the distraction. At present, fronto-facial monobloc advancement is not considered as a routine technique in the institutional protocol.

Sometimes patients present with a severe deformity requiring more individualized treatment. In such cases, other treatment strategies and techniques may be adopted to ensure safe and successful surgery.

EDUCATION

2000 Graduate from Keio University School of Medicine

CAREER HISTRY

[2010 March-present] Attending Surgeon, Director (July 2014-), Department of Plastic and Reconstructive Surgery, Tokyo Metropolitan Children's Medical Center
[2009-2010] Attending Surgeon, Department of Plastic and Reconstructive Surgery, Tokyo Metropolitan Kiyose Children's Hospital
[2008 December-] Visiting scholar, Craniofacial Center Chang Gung Memorial Hospital
[2008 June] Visiting fellow and observer, Australian Craniofacial Unit
[2007-2008] Attending Surgeon, Department of Plastic and Reconstructive Surgery, Tokyo Metropolitan Kiyose Children's Hospital
[2006-2007] Instructor, Department of Plastic and Reconstructive Surgery,Keio University
[2005-2006] Attending Surgeon, Department of Plastic and Reconstructive Surgery, National Tokyo Medical Center
[2004-2005] Chief Resident, Department of Plastic and Reconstructive Surgery, Keio University
[2003-2004] Department of Surgery, Tokyo Metropolitan Kiyose Children's Hospital
[2002-2003] Department of Surgery, Mito Kyodo Hospital
[2000-2002] Resident, Department of Plastic and Reconstructive Surgery, Keio University

LICENSURE

Active Member, Asian Pacific Craniofacial Association
Active Member, International Society of Craniofacial Surgery
Board Certification for Plastic and Reconstructive Surgery, Japan
Board Certification for Cranio-Maxillo-Facial Surgery, Japan
Board Certification for Pediatric Plastic Surgery, Japan

Dec. 15, Room A

Meet experts 3 (Luncheon seminar): Surgery for pediatric congenital deformative craniovertebral junction (CVJ) lesions

Management of complex Craniovertebral junction (CVJ) surgery in children

Ryo Ando

Department of Neurosurgey, Chiba Children's Hospital

CVJ region is one of the complex structures in terms of embryological development. Congenital misstructure can easily occur in such region. CVJ takes several roles mechanically and physiologically.
1) Stability and mobility
2) Neural transformation from brain to cervical spinal cord
3) CSF dynamics between posterior cranial fossa to spinal canal
Another factor we should take into consideration is that children's spine is growing structure. Sometimes, follow-up observation for natural course or minimum conservative approach is better way rather than hasty surgical intervention. This presentation will discuss the management of complex CVJ surgery in children especially focusing on complex Chiari malformations, spinal deformities with segmentation failure, and skeletal dysplasia.

Complex Chiari is the pathological concept described by Brockmeyer group recently. According to their description, the patients with brain stem herniation or Chiari malformation type 1.5, basilar invagination, and Clivo-axial angle(CXA)<125°are at higher risk of Occipito-cervical(OC) fusion. This means more complicated anatomical variance provokes refractory pathophysiological condition of Chiari malformation. On our experience, the patients with CXA<125°and Klause index<25mm tend to present syringomyelia and to become symptomatic which require surgical intervention in earlier stage of their life. The procedure is basically decompression, including additional tonsillectomy. No patients underwent anterior decompression or OC fusion so far.

Segmentation failure in developing spine can cause complex spinal anomaly. Though the number is limited, three patients are described here. The patient with the fusion or separation failure of clivus and apical segment of dens showed C1-2 instability, and posterior fixation was required. Second patient with multiple complex segmentation failure who had the past surgical history of Foramen magnum decompression (FMD) and C1 laminectomy, presented with acute transient episode of upper and lower extremities weakness after trauma. The patient had another stenotic lesions at the level of C3-5 though, she remained stable with conservative management of mild exercise restriction only. Third patient with facet hypoplasia of C4-6 demonstrates hyperlordosis resulting in retroflexed odontoid and basilar invagination causing anterior compression of brain stem. She underwent transoral odontoidectomy followed by O-C2,3 fusion.

In Skeletal dysplasia, achondroplasia is the most common. Although anatomy of foramen magnum (FM) varies considerably from normal population, FMD including lateral aspects of FM is usually the operative technique of choice. Stenosis is the predominant pathology in achondroplasia. Chondrodysplasia punctata (CDP) is characterized by punctate calcification of the vertebral body

and instability due to hypoplasia of the anterior element. Among five our patients, three of which had paralysis from early on, were treated with C1 laminectomy only, with additional cervical collar wearing. The other one requires posterior fusion. Metatropic dysplasia, so named because of the progressive spinal deformity, was treated with FMD and C1 laminectomy in two of four our patients. In one case, restenosis due to hyperosteogenesis occurred, and O-C4 re-decompression was added.

To deal with complex CVJ lesions in children, appropriate choice of timing and surgical technique is mandatory. Sometimes staged treatment is preferable in selected patients according to developing spine.

Education
1998-2004: School of Medicine, Tsukuba University (M.D.)

Certification and Licensure
2004: Japan Medical License
2010: Board Certification, Japan Neurosurgical Society
2015: Board Certification, Japanese Society of Spinal Surgery

Professional Training and Employment
2004-2006: Junior Residency, Asahi General Hospital (Chiba, Japan)
2006-2009: Senior Residency, Department of Neurosurgery, Asahi General Hospital
2009-2010: Medical staff, Department of Pediatric Neurosurgery, Chiba Children's Hospital (Chiba, Japan)
2010-2011: Medical staff, Department of Spinal Surgery, Kameda Medical Center (Chiba, Japan)
2011-2012(Apr): Senior Surgeon, Department of Spinal Surgery, Kameda Medical Center (Chiba, Japan)
2012(May)-2014(Mar): Medical staff, Department of Pediatric Neurosurgery, Chiba Children's Hospital (Chiba, Japan)
2014(Apr)-: Senior Surgeon, Department of Pediatric Neurosurgery, Chiba Children's Hospital (Chiba, Japan)
2020(Apr)-preesnt: Chief Surgeon, Department of Pediatric Neurosurgery, Chiba Children's Hospital (Chiba, Japan)

Academic Award
2015 Best Paper Award, Symptomatic Chiari type-2 malformation. To operate or not to operate? Consideration of its natural history. 1st Congress of Asian-Australasian Society for Pediatric Neurosurgery and Inaugural Meeting
2015 Best Presentation Award, Decompressive surgery for high cervical stenosis in metatropic dysplasia. The 27th Annual Meeting of KSPN and 2015 JSPN-KSPN Joint Meeting

Dec. 15, Room C

Meet experts 4 (Luncheon seminar): How to start up intraoperative neurophysiological monitoring in pediatric neurosurgery

Spinal surgery: motor, sensory & urinary function

Tsunenori Takatani

Department of Anesthesiology, Nara Medical University

Dec. 15, Room A

Symposium 7: Tethered cord syndrome: how to diagnose, when and how to operate?

Diagnosis, surgical procedure, and prevention of re-tethering

Toshiaki Hayashi

Miyagi Children's Hospital

Preference: Spinal lipomas can be classified into two major types, lipoma of the filum terminale and lipoma of the conus medullaris(LCM). LCM often causes neurological symptoms known as tethered cord syndrome (TCS). The symptoms can be seen at diagnosis and during long-term follow-up. In this report, we present the long-term results of surgical treatment of pediatric LCM in our department and discuss the treatment strategy for CL in the literature. Possible risk factors for retethered cord syndrome (ReTCS) were evaluated in the long-term follow-up period.

Methods: Consecutive pediatric patients with LCM who underwent first untethering surgery and were followed for more than 100 months were retrospectively analyzed. Pre- and postoperative clinical and radiological data were reviewed to analyze the outcomes of surgery and identify potential risk factors for ReTCS. The surgery was performed with a partial removal technique under continuous intraoperative electrophysiological monitoring, including monitoring of anal sphincter and calf muscles. Briefly, after exposure of the lipoma, detethering of the spinal cord was performed by cutting the lipoma or tethering bands. Subpial removal of the lipoma was performed using an ultrasonic aspiration system. The aim of lipoma removal was to release the spinal cord from the dura and allow CSF to surround the spinal cord and lipoma complex without injuring the spinal cord and roots. Lipomas were not removed aggressively. Aberrant roots were cut under electrophysiological monitoring. If the roots were involved in the lipoma, the lipoma was either minimally removed or not removed to protect the roots and the surrounding pial surface. The pia that was seen around the stump of the removed lipoma was approximated to reconstruct the pial surface. If the dural defect did not allow primary dural closure, such as surgery for lipomyelomeningocele, the dural defect was repaired using a fascia patch

Results: During follow-up, the overall 10-year and 15-year progression-free survival rates were about 80% and 75% respectively. On Univariate analysis, lipoma type of Lipomyelomeningocele, age at surgery, and mean growth rate after surgery were significant factors associated with ReTCS. Cox proportional hazard models showed that lipoma type of lipomyelomeningocele and mean growth rate after surgery were significantly associated with the occurrence of ReTCS.

Discussion: The more complex lesions and high growth rate after surgery seem to increase the risk of ReTCS. Considering that the highest growth rate is seen in infancy, to perform prophylactic surgery in infancy for LCM with a high risk of adhesion, such as lipomyelomeningocele and transitional LCM may not be a good option. However, the dilemma is that TCS symptoms in infancy are not always easy to diagnose. Larger prospective studies and registries are need to define the risk of ReTCS more adequately.

Education and Academic Qualifications:

1994	Graduated from Tohoku University School of Medicine
1994	Medical Doctor, Japan Ministry of Health
2001	Ph.D (Medical Science) Tohoku University Graduate School of Medicine, Sendai, Japan
2001	Board Certified Neurosurgeon, Japan Neurosurgical society

Employment:

2003-2012	Chief, Department of Neurosurgery, Miyagi Children's Hospital, Sendai, Japan
2012-2018	Chief, Department of Neurosurgery, Sendai City Hospital, Sendai, Japan
2018-2020	Associate Professor, Department of Neurosurgery, Tohoku Medical and Pharmaceutical University, Sendai, Japan
2020-present	Director, Department of Neurosurgery, Miyagi Children's Hospital, Sendai, Japan
2021	Professor, Department of Pediatric Neurosurgery, Tohoku University, Graduate School of Medicine

Award:

2001 Tohoku Cerebrovascular Disorders Research Association Award
2010, 2020 Jiro Suzuki Award, Department of Neurosurgery, Tohoku University
2013 Kawabuchi Award, Japanese Society of Pediatric Neurosurgery

Dec. 15, Room A
Symposium 8: Surgery for pediatric hypertonia

ITB in Asia-Australasia

Shiro Horisawa
Tokyo Women's Medical University

Dec. 15, Room A

Symposium 9: Management of neonatal intraventricular hemorrhage (IVH) & subsequent hydrocephalus

Management of neonatal IVH in Japan

Young-Soo Park

Department of Neurosurgery and Children's Medical Center, Nara Medical University

Remarkable advances in neonatal care have significantly improved the survival of extremely low birth weight infants (ELBWIs) in recent years. However, intraventricular hemorrhage (IVH) and subsequent post-hemorrhagic hydrocephalus (PHH) remain to be major complications in ELBWIs, leading to a high incidence of cerebral palsy and cognitive impairment. Fragile infants are targeted and their treatment requires special attention and various difficulties. Although no standard management has been established, a common treatment strategy is to provide temporary treatment such as ventricular drainage, ventricular reservoir, or ventriculosubgaleal shunt, followed by permanent ventriculoperitoneal shunt (VPS) after the infant grows. However, VPS for PHH in premature infants leads to a variety of troublesome shunt-related complications, including infection and ventricular catheter obstruction at a non-negligible incidence, further worsening functional outcomes.

In recent years, it has been elucidated that poor neurological functional prognosis is also due to long-term brain exposure to the hematoma itself and its dissolution products. Challenging treatment strategies are being attempted to improve neurodevelopmental function, including cognitive function, with the key concept of aggressively removing the hematoma and avoiding VPS.

Two challenging treatment strategies are being tried, one is neuroendoscopic ventricular lavage (NEL) and the other is fibrinolytic therapy. These two treatment strategies are undoubtedly aggressive and promising treatments for PHH in ELBWIs. Based on the results of studies reported since 2000, clinical outcomes, including VPS requirement rates, complication rates such as infection and secondary bleeding, and cognitive function, were similar between the two treatment groups. However, advanced surgical techniques are essential to perform NEL, and there are limitations in its application to patients with extremely small brains and without highly enlarged ventricles.

Considering various factors, the ideal treatment strategy for PHH in ELBWIs is currently considered as follows. Step 1) EVD management with fibrinolytic therapy using urokinase (not tPA), Step 2) NEL if possible, Step 3) intermittent CSF drainage with ventricular reservoirs, or ventriculosubgaleal shunt, which has long been the standard of care. When progressed PHH cannot be controlled with these therapies, VPS is the final treatment option.

This lecture will outline the fibrinolytic therapy using urokinase that is being tried in Japan. Our fibrinolytic treatment consists of the following approaches. 1) continuous intracranial pressure control from the early PHH stage; 2) morphological recovery of the brain mantle volume as soon as possible; 3) rapid hematoma dissolution and wash out; 4) reduction of free radicals and inflammatory cytokines; 5) restoration of physiological cerebrospinal fluid (CSF) dynamics; and 6) avoidance of permanent VPS placement.

Until recently, the main goal of IVH and subsequent PHH treatment was to reduce mortality, since the treated infants were vulnerable premature infants. And only how to safely perform permanent VPS

surgery has been considered as an objective. However, the troublesome shunt-related complications should prompt consideration of treatment guidelines that avoid VPS placement. Pediatric neurosurgeons should be proactive in reducing the risk of periventricular white matter injury and improving neurodevelopmental outcomes.

Education and Professional Career

1990	M.D., Faculty of Medicine, Nara Medical University, Nara, JAPAN
2006	Ph.D., Graduate School of Medicine, Nara Medical University, Nara, JAPAN
1990-2002	Resident in Department of Neurosurgery, Nara Medical University Hospital and the affiliated hospitals
2003	Assistant Professor, Department of Neurosurgery, School of Medicine, Nara Medical University, Nara, JAPAN
2006-2007	Post-doctoral clinical fellow, Department of Pediatric Neurosurgery, Rome Catholic University, A Gemelli Hospital, Rome, ITALY (Professor C. Di Rocco)
2008	Lecturer, Department of Neurosurgery, School of Medicine, Nara Medical University, Nara, JAPAN
2012~	Associate professor, Department of Neurosurgery, School of Medicine, Nara Medical University, Nara, JAPAN
2016~	Clinical professor, Division of Children's Medical Center, Nara Medical University Hospital, Nara, JAPAN

Main field of Interest

Pediatric Neurosurgery, Neuroendoscopy, Neurotrauma, Spinal Surgery

Dec. 15, Room A
Symposium 10: Moyamoya disease: what is the best practice?

Japanese Guideline of Moyamoya disease

Satoshi Kuroda
Department of Neurosurgery, University of Toyama