

International Hydrocephalus Imaging Working Group

April 21st–22nd 2011 Meeting, Chiari Institute, Great Neck, NY, USA

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Summary report

On April 21st–22nd a new meeting took place at the Chiari Institute in New York after an invitation from its chairman, Dr. Rekate.

In May of 2010 the 5th International Workshop for Hydrocephalus was held in Crete Greece. One of the pervasive concepts that resulted from this meeting was the concept that new MRI technology could and should be utilized as a powerful tool for the study of basic science research in human hydrocephalus. The challenges in moving forward in such study related to the need for diverse disciplines to be able to communicate and work collaboratively. Experts in basic science research in hydrocephalus, neuroradiologists with specific expertise in studying the effects of abnormalities of CSF dynamics and engineers working on expanding the utility of MRI technology in studying hydrocephalus met on Long Island to plan cooperative studies utilizing MRI. The group decided that it would call itself the **International Hydrocephalus Imaging Working Group** (IHIWG).

Attendees:

Harold L. Rekate MD	Host	Neurosurgeon	The Chiari Institute
Grand Bateman MD	Neuroradiologist		Australia
Mark Wagshul PhD	Physicist/Engineer		Albert Einstein College of Medicine Bronx New York
Charles Raybaud MD	Neuroradiologist		Hospital for Sick Children Toronto, Canada
Vartan Kurtcuoglu PhD	Engineer/Physicist		Director the Smart Shunt Program, Zurich, Switzerland currently Visiting Scientist Boston
Norman Relkin MD/PhD	Cognitive Neurologist		Weill Cornell College of Medicine
j Patrick (Pat) McAllister PhD	Professor of Neurosurgery in Basic Science		University of Utah
Roger Kula MD	Medical Director, The Chiari		Institute Hofstra Northshore LIJ College of Medicine

Effie Kapsalaki Fountas MD	Neuroradiology	Larissa Greece
Konstantinos Fountas MD	Neurosurgery	Larissa Greece
Karen Black MD	Chairman of Neuroradiology	Northshore LIJ Health System
Azziz Ulug PhD	Engineer/Physicist	The Feintstein Institute, Northshore LIJ Health System.
Aristotelis Filippidis MD/PhD	Neurosurgery/Basic Science Research	
Petra Klinge MD/PhD	Neurosurgery/Basic Science Research	Brown University, Providence RI
Thomas Brinker MD/Phd	Neurosurgery/Basic Science Research	Brown University, Providence RI
Gunes Aygok MD	Clinical Neurosurgery	Medical College of Va. Richmond, Va
Ilhan Kayis PhD	Engineer/Physicist	Virginia Commonwealth University Richmond, VA
William Bradley MD	Neuroradiology, Chairman of radiology,	University of California, San Diego and researcher into the pathophysiology of Normal Pressure Hydrocephalus

Imaging methods and consensus discussion

Several members of the committee that developed the guidelines for Normal Pressure Hydrocephalus treatment and diagnosis were present at this meeting (Aygok and Relkin). It was decided that there was a missing piece of the puzzle for the guidelines and one of the priorities of the work of the working group.

Clinicians, neurosurgeons, engineers, physicists, and biologists face many challenges in working together in understanding Normal Pressure Hydrocephalus and other abnormalities of CSF dynamics. In order to approach the solution to NPH pathophysiology and treatment. It is critical to develop meetings, which involve all of these scientists around the same table in order to create a common language and share ideas and initiatives.

Imaging concepts

DTI: what is its role in NPH? Pathophysiology? Treatment correlation? Animal models and DTI. It seems that fractional anisotropy measurement is specific ROIs are important. The need to average the measurements from the same ROIs was brought up in order to reduce error. Should we use it as a quantitative or qualitative tool? The FA in the periventricular white matter is reduced in NPH

Ventriculomegaly: How we define it? The era has come to create a volumetric atlas in 3D which should be age-gender matched.

Diffusion protocols in MRI and NPH: A new protocol presented by Aziz Ulug and Norman Relkin which can differentiate controls, NPH and Alzheimer's. What we can get out of this?

MRI elastography: It has probably a role in experimental setting in order to study certain aspects of the NPH pathophysiology.

ASL (Arterial Spin Labeling): it provides an estimation of the cerebral blood flow but currently we are not sure about interpretation because we probably get more data in a cellular level that can be imposed on clinical data.

CSF flow studies in subarachnoid space: currently they require manpower and time. A need for optimization and sharing of big datasets is imperative.

Phase-contrast MRI-CP: attempt to measure ICP non invasively (Noam Alperin). It is promising.

Arterial inflow-Venous outflow studies: Significant to understand the pathophysiology and provide a DDx at the vascular level. Collateral flow as a surrogate marker of pressure if you measure the arterial inflow and assess the venous outflow too. (Grant Bateman).

A correlation with treatment and outcome was also part of the imaging discussion. The key question was whether all the imaging armamentarium can identify or predict the outcome. Additionally an effort to correlate CSF or other biomarkers of disease with MRI protocol studies was also discussed.

Basic research background

Two paths were discussed. The first one is the use of MRI as a non-invasive tool to conduct human research in NPH which provides a great tool to directly see, understand and interpret findings in NPH.

The second path dealt with lab research, which uses animal imaging models of NPH and DTI with or without kaolin based HCP models, stem cell bioreactor models for regeneration of CNS tissue, modeling of the subarachnoid space with computational fluid dynamics, metabolic changes in HCP, modeling the cortical subarachnoid space in the cellular level as well as its vascular distribution. Pulsatility in terms of stroke volume was discussed, as well studies relating it to changes after shunting, decompressive craniectomy.

Proposed theories

Harold Rekate brought up the new classification of Hydrocephalus where a point of obstruction is always present except for the case of choroidal hyperplasia.

William Bradley proposed that NPH is a two hit hypothesis. He proposed that it starts as a Benign External Hydrocephalus as a baby (first hit) then Ischaemia comes as a second hit in adults, which leads to NPH.

Charles Raybaud presented developmental MRI data in newborns and pointed out significant differences in the skull expansion in newborn which is due to CSF pressure while in older children this is due to the expansion of the brain.

Funding

The members thoroughly discussed potential funding sources. Among them the following were mentioned: NIBIB, NIDDS, Hydrocephalus Association (Joseph Lukash), Hydrocephalus working group for HCP in NIH (meets every month), ADNI (Alzheimer's Disease Neuroimaging Initiative), HCRN, Chiari-Syringomyelia Foundation, potential grants from Europe (ERC grants).

Meetings of the IHIWG

Attempt to meet once every month was decided with the implementation of teleconference modules. Also meetings of the members should take place at the various Hydrocephalus meetings or conferences where the Imaging perspective in NPH should be brought up.

Copenhagen meeting

The participation of this group to the upcoming Copenhagen meeting (Hydrocephalus 2011 meeting - September 4-7 2011) was decided. A meeting of the members in the morning of 4th September before the start of the conference was agreed.

Subcommittees formed

Communications Committee: The goal here is to review various platforms for Webinar or webcasting our meetings since the group is distributed over the world

Roger Kula

Aristotelis Filippidis

?Aseem Chandra

Vartan Kurtcuoglu

Aziz Ulug

European subcommittee: Reaching out to researchers in Europe with specific interest in MRI as a research tool and hydrocephalus (?Sprung)

Effie Kapsalaki Fountas

Kostas Fountas

Petra Klinge

Vartan Kurtcuoglu

Pediatric subcommittee: Reaching out to the pediatric neurosurgical hydrocephalus community

Hal Rekate

Charles Raybaud

NPH Guidelines committee:

Gunes Aygok

Norman Relkin

Bill Bradley

Karen Black

Basic Science committee

Pat McAllister

Petra Klinge

Thomas Brinker