

Discussion Summary

Conquer Chiari Research Conference '14

Advancing Diagnosis, Management & Understanding



Since its humble beginnings at the University of Illinois at Chicago in 2007, Conquer Chiari has organized five bi-annual research conferences which have featured the research projects of various clinicians, surgeons, neurologists, scientists, psychologists, and social workers within the medical and scientific communities.

This year, the University of Akron (home of the Conquer Chiari Research Center) hosted The Conquer Chiari Research Conference featuring twenty-five professional presentations by local and international individuals within the healthcare and scientific communities who are focused on understanding and fighting Chiari.

The conference was led by organizers:

- Rick Labuda, Executive Director of Conquer Chiari
- Dr. Francis Loth Ph.D., Executive Director of the Conquer Chiari Research Center
- Dr. Konstantin Slavin, MD from University of Illinois-Chicago

A special thanks also goes out to Conquer Chiari's primary scientific and medical supporters and sponsors who attended this year:

- The University of Akron
- The Conquer Chiari Research Center
- The University of Illinois at Chicago
- Column of Hope

Conquer Chiari Research: A Strategy for Success

To begin the conference, Mr. Rick Labuda delivered a presentation on how Conquer Chiari functions as a non-profit organization dedicated to improving the experiences and outcomes of Chiari and patients through education, awareness, and research. Innovation is also a large part of Conquer Chiari's mission which is highly driven by the community's generous donations that mainly supports Chiari-related research. By creating a self-sustaining research ecosystem, maximizing return and minimizing risk through balanced research programs, and establishing a world class multi-disciplinary Chiari focused research center, Conquer Chiari has reached many of its objectives and goals thanks to all of its supporters around the world. Rick Labuda confidently concluded his speech by saying, *"We have a strategy in place, we are building an infrastructure, and we have great personnel and tremendous partners working on various projects—we are Conquering Chiari."*

Maternal Depression, Prenatal SSRI Exposure, and Chiari I Malformations

Dr. Rebecca Santelli, from the University of North Carolina, shared her findings on the effects of selective serotonin reuptake inhibitors (SSRI), or antidepressants, used by pregnant women. She reported that 15-20% of women experience depression when they are with child and over 13% decide to fill SSRI prescriptions. In Dr. Santelli's research study, the long term-effects on children who have any kind of exposure to SSRI are unknown; however, she reported that 20% (3 out of 15) of her younger participants were diagnosed by radiologists with Chiari I after they were born. She ended her presentation by saying that children who have SSRI exposure may have an increased risk of complications which may also be linked to Chiari malformation.

Neurosurgeon's Perspective on Chiari Research

Cleveland Clinic neurosurgeon, Dr. Mark Luciano, gave an insightful and analytical examination into the diagnosis of Chiari malformation. He first explained that genetics as well as the environment play a substantial role in determining a person's anatomy; although doctors and scientists have determined these important aspects of the body's form, they have yet to fully understand the complexity of its structure. However, by studying the restricted motion of cerebral spinal fluid (CSF) within the skull and spine of a Chiari patient, doctors can establish that one or both of the cerebellar tonsils are creating pressure on the brainstem as well as within the spinal cord. Furthermore, with each pulse of CSF, the brain may move further down, increasing the symptoms of Chiari, and possibly create additional complications overtime including chronic pain, hypersensitivity, and inflammation. *"Chiari only becomes symptomatic when other factors start to play a role. It may be important to get rid of the initial cause with decompression surgery, but other factors are also important and we have to pay attention to getting rid of those symptoms as well or we fail even with a successful decompression,"* explained Dr. Luciano. By looking at these elements of Chiari, doctors will be able to better assist their patients to help relieve problematic symptoms in the future.

Influence of Chiari Malformation I on Affective and Cognitive Performance

Dr. Phil Allen, from the University of Akron and the Conquer Chiari Research Center (CCRC), decided to conduct an ongoing study which measures the cognitive functions of Chiari I patients. He was ultimately interested in determining whether the cerebellum had sustained damage even after decompression surgery was performed. Twenty-four post-op, opiate free individuals were contacted to participate in this evaluation which measured the management, regulation, and control of their executive functions— working memory, reasoning, task processing, and problem solving abilities.

Although the Chiari I patients had no memory difficulties or delayed recall, they had problems with responding to and managing changing situations, environment, and other forms of stimuli compared to those without Chiari. Dr. Allen found that many of the individuals in his study with Chiari I suffered from executive dysfunctions which prohibits them from self-regulating their own behavior (e.g. keeping track of time, finishing work on time, inability to reflect on past knowledge, multitasking).

Unraveling the Chiari/Pseudotumor puzzle

The Chiari Care Center was represented by Dr. John Oro, a neurosurgeon and the Medical Director of Neurosciences at The Medical Center of Aurora, who reported on the historical “puzzle pieces” of Chiari and pseudotumor cerebri. [“We are starting to understand the symptoms of Chiari and elevated intracranial pressure \(ICP\), a large element of pseudotumor cerebri. Once we start separating the two conditions, we can better evaluate and treat patients according to their individual situations,”](#) said Dr. Oro. Those suffering from Chiari and pseudotumor cerebri (10%) often have symptoms such as moderate to severe headaches located behind the eyes, pulsatile tinnitus, vision problems, nausea, and dizziness. Medicinal and surgical treatments of these complications are usually employed by doctors to manage ICP or intracranial hypertension, which are often associated with pseudotumor cerebri. Dr. Oro spoke of two females—one 26-years-old and the other 12—who were diagnosed with Chiari I; they were both surgical candidates however, after taking diamox their tonsillar herniation’s improved as well as their symptoms. However, not every patient has improvement with just medicinal treatment. Considering that Chiari is an ever-changing condition which may cause additional complications, Dr. Oro believes that designing a neuro-panel in the future will help neurologists and neurosurgeons further understand Chiari and its related conditions.

Syrinx Morphology Predicts Syrinx Etiology: Implications for Chiari-associated Syrinx

Dr. Jennifer Strahle, the chief neurosurgery resident at the University of Michigan, presented her study on Syringomyelia and its presence in the spinal cord. [“Our hypothesis was that each syrinx appears differently based on their location, width, and length in the spinal cord. Information presented shows that not all Chiari associated syringes are equal and that some syringes may not necessarily be associated with Chiari where others are clearly related,”](#) explained Dr. Strahle. The presence of syringomyelia in the spinal cord was determined by fluid filled cysts which were greater than or equal to 3 millimeters wide in the case of this study. The majority of individuals involved were women with Chiari I who had syringes in the cervical spine averaging about 8 millimeters and also had pronounced scoliosis (60%). Some syringes present with Chiari are idiopathic, or have unknown causes, but others falling under the “Chiari syrinx” category are wider and larger than those found in idiopathic syringomyelia. All of these factors may impact a doctor’s decision to operate or how they chose to administer care. The way that syringes are formed and defined by doctors can determine how the condition is understood and further developed in Chiari patients. However, Dr. Strahle states that further studies are needed to utilize the current developments of syringomyelia in the medical community.

Surgical Outcomes Using Wide Suboccipital Decompression for Adult Chiari I Malformation with and without Syringomyelia

Dr. Mario Ammirati, a neurosurgeon at The Ohio State University Wexner Medical Center, reported his study on suboccipital decompression to relieve the progressive symptoms of Chiari. The patients in his study were responsible for recollecting information from when they were first decompressed between 2007 and 2013. Dr. Ammirati shared that the overall goal of the surgery was to relieve the symptoms of Chiari, to re-establish normal CSF flow/circulation, and to achieve a reduction of syrinx size. When measuring outcomes, patients were asked to classify their post-op status, after an average of 27.5 months, as improved, stable, or worse. 90% said that they had an improved outcome, 3% stated that they were stable, and 7% claimed their symptoms were worse. When reviewing syrinx size, most of the individuals

involved had an 86% reduction while one person had a complete resolution. Dr. Ammirati concluded that wide suboccipital decompression had an overall favorable outcome in 90% of patients within this study.

Measuring Brain Motion in CMI

Dr. Bryn A. Martin, the director of the Conquer Chiari Research Center at the University of Akron, addressed what lies beyond the abnormal symptoms and signs associated with Chiari— the biomechanical and engineering aspects of Chiari malformation. When cerebellar tonsils are descending into the spinal canal, they interrupt the flow of CSF which in turn causes a strain on the brainstem. In a normal MRI, no visible motions of the brain are detected in individuals who do not have tonsillar herniations; therefore, resistance is not an issue with non-Chiarians. By evaluating decompressed Chiari patients, Dr. Martin was able to measure a 27% motion decrease of the brain in relation to CSF flow within the spinal cord. [“With this study, we showed a foundation for a possible mechanistic linkage between the resistance of flow and motion of the brain and spinal cord as well as the deformation of tonsillar descent,”](#) shared Dr. Martin, who hopes to continue this biomedical study in the future on brain motion in Chiari patients.

Morphometric-Based Classification for Chiari Malformation I

Dr. Malena Espanol, an assistant professor in the Department of Mathematics and a CCRC research member at the University of Akron, reported on the idea of employing a mathematical model to classify Chiari, instead of only depending on the length of tonsillar herniation. [“For our study, we used the idea of classifying Chiari using morphometric measurements, but you can calculate different anatomical features with the data you obtain from within the body,”](#) said Dr. Espanol. Furthermore, by using mathematics to measure certain aspects of the anatomy, the medical community will be able to use a wider range of analysis techniques to assess physical mutations or possibly even changes in genetic makeup. In Dr. Espanol’s study, those with a herniation greater than 5mm had clinically significant symptoms while those with less than 3mm didn’t have any serious issues. By collecting statistical data, Dr. Espanol and her team were then able to make a logistic regression model, which generally predicts probability/odds, to describe the differences between healthy patients and patients with Chiari. Furthermore, additional research on morphometrically classifying Chiari may help clinicians better understand measurements of the brain and spinal cord in the future.

Pathophysiology of Syringomyelia

Dr. Marcus Stoodley, a professor of neurosurgery at The Australian School of Advanced Medicine (Macquarie University), presented his collected data on how syringomyelia creates high pressure within the skull and spinal cord. [“Considering that the cerebellar tonsils and spinal cord have an increase of motion when syringomyelia is involved, it can be hypothesized that the presence of a syrinx increases the pressure of the CSF which also creates strain on the brain,”](#) said Dr. Stoodley. When the cerebellar tonsils descend into the spinal cord, they slow or block the CSF flow. Consequently, these tonsils pulse and gradually descend with each heartbeat. The tonsillar strain, which is experienced by most Chiari patients, is also considerably greater in individuals with exertion headaches—brought on by coughing, sneezing or any other type of straining. After undergoing a successful decompression surgery, the CSF flow is alleviated of pressure since more space is created in the skull and spinal cord; in addition to this, the movement of the cerebellar tonsils decreases as well after decompression. In the future, Dr. Stoodley wants to further his research on syringomyelia as well as develop a technique which precisely measures CSF flow.

New Concepts for Chiari

Dr. Cormac Maher, a neurosurgeon from the University of Michigan, spoke about his general research on Chiari worldwide. He also included information from the [“Chiari Type I Malformation in a Pediatric Population”](#) retrospective

study, where 741,815 children (under the age of 20) from Kaiser Northern California underwent head and spine MRI scans between the years of 1997-1998. Of all these children, 51 were diagnosed with Chiari after completing head and spine MRIs; furthermore, 32 of these patients had symptomatic Chiari while 19 were asymptomatic. Sports participation was next discussed and over half (64%) of patients, or their caregivers, decided to discontinue recreational activities after being diagnosed and/or undergoing surgery. Dr. Maher also included a second study with adult patients where 175 out of 22,591 MRI scans found Chiari I incidentally (Meadows J. 2000). He then spoke about trends of diagnosis in adult patients—the most prevalent ages being 30, 55, and 71. To conclude his presentation, Dr. Maher addressed the patrons of the medical community stating that the steady continuation of pediatric and adult research is vital to understanding the diagnosis of Chiari.

Transcriptomics and Metabolomics Analyses to Reveal the Syrx Biochemical Environment in a Rat Model of Cervical Syringomyelia

Dr. Nic Leipzig, an Assistant Professor of Chemical and Biomolecular Engineering as well as a CCRC team member at the University of Akron, presented his findings on the molecular processes, specific to nerve damage and healing, of a rat with syringomyelia. Current statistics show that over 200,000 Americans are affected by syringomyelia, however not many individuals understand its damaging nature within the bodies of both humans and animals. Interestingly enough, most Cavalier King Charles Spaniels are naturally born with syringomyelia since it is passed on through each generation. To study the effects that syrinxes have within the body, Dr. Leipzig modified the spinal cords of rats to generate a syrinx, which were in fact remarkably similar to those found within a human spinal cord. The rodents were then used to evaluate neuropathic pain depending on how severe, or sizable, the syrinxes were when measured overtime. After analyzing his data, Dr. Leipzig discovered that syringomyelia eventually impaired its host if the condition was left untreated over a long period of time. In the future, Dr. Leipzig hopes to come to an understanding of syringomyelia and develop treatments for those who are suffering.

Keynote Topic: A New Brain in an Ancient Skull Base

During the dinner hours, conference attendees enjoyed a presentation by Keynote Speaker, Dr. Yvens Fernandes, a Brazilian physician and neurosurgeon. He spoke of a “Bridge of Knowledge” which was only made possible by using the combined powers of neurosurgery and anthropology. By using the science of genetics and molecular anthropology, humanity is able to tie itself back to its humble beginnings in Africa, otherwise known as the Cradle of Humankind. Through explaining the evolution of the human brain, Dr. Fernandes informed those in attendance that currently all of our brains, as humanoids, are 5x larger than predicted and one of nature’s most beautiful masterpieces. Thanks to our brains, we are able to control fire, cook for ourselves, survive in a harsh environment, compete with others, and use various tools to understand the world around us to expand our intelligence. However, with great power comes even greater responsibility—in other words, hoping that our anatomical evolution will catch up with our expanding brains. Our facial structures have been steadily changing throughout time and as a result of this, our skull bases have become much shorter than any other mammal, which eventually leads to conditions such as Chiari. Dr. Fernandes termed this transformation as braincase desynchronization—where the clivus (a bone inside of the skull) continues to grow, which takes up additional space, and causes the brain to be shifted down into the spinal cord. [“The changes in the environment and in humanity’s anatomical structure have caused a plethora of diseases such as Chiari which have led some to believe that nature never finished thinking us. We need to start thinking about Chiari not as a malformation, but as a footprint that has been presented to us to analyze and further understand the changes in our anatomy,”](#) concluded Dr. Fernandes.

Clinical Patterns Seen with Cervical Medullary Syndrome

Dr. Roger W. Kula, an Associate Professor of Neurology and Neurosurgery as well as the Medical Director at the Chiari Institute, presented his research on the clinical patterns of Chiari and syringomyelia. [“Today, Chiari is generally known as a hindbrain herniation; however, the medical community has an opportunity to improve and revise the traditional terminology and confusing nomenclature associated with Chiari malformation through many expansive research studies,”](#) said Dr. Kula. Symptomatic Chiari patients often suffer from cervical medullary syndrome often associated with pressure-like headache pain (provoked by forms of exertion), pains in the neck, muscle spasms, ear pains, problems with vision (blurriness, floaters, auras), troubles with balance, sleeping issues, difficulties speaking and swallowing, troubles with cognition, behavior issues, and sometimes cardiac, gastrointestinal, or autonomic problems. In conjunction with cervical medullary syndrome, Dr. Kula concluded that Chiari patients mostly suffer from ten major symptoms: headache pains (82%), neck pain/stiffness (78%), prickling/tingling/numbness in limbs (73%), dizziness (70%), headaches worsened by straining (64%), headaches associated with pressure behind the eyes/ears or sensitivity to light (63%), balance issues (62%), chronic fatigue, cognitive, and behavioral problems (62%), weakness/stiffness in limbs (55%), and troubles with vision, hearing and breathing (53%).

Combined Exome Sequencing and Whole Genome Linkage Analysis in Familial Chiari Malformation Type I

Dr. Aintzane Urbizu, a visiting genetics researcher at the Conquer Chiari Research Center, was awarded a post-doctoral fellowship grant of \$36,000 per year from the Ramón Areces Foundation in Madrid, Spain, and \$20,000 for materials and supplies from Conquer Chiari to continue her exploration of Chiari malformation found within familial lineage. By analyzing genome links, Dr. Urbizu was able to investigate traits which were inherited by various family members. During her prior genetic and morphometric study in 2013, she encountered a family of sixteen who had twelve immediate members diagnosed with Chiari. [“There are more than three hundred genes which make up rare disorders associated with Chiari I—this is why it was important to use an accurate analysis strategy to look for mutations or variations in genetic material,”](#) Dr. Urbizu explained. Although several variants were found during the family’s genome analysis and exome sequencing, Dr. Urbizu and her team could not confidently conclude that any of the genes caused Chiari I. During her conclusion, she explained that additional genetic research should be employed in the future to better understand familial ties to Chiari malformation.

Metabolomic Analysis of Disorders of CSF Flow

Dr. Leah Shriver, a professor in the Department of Chemistry and Biology at the University of Akron, created a study which presented measurements of metabolic response as well as indicated inflammatory pain reactions of Chiari patients. By hopefully generating precise data, Dr. Shriver aimed to improve future prescription drug development and delivery treatments for chronic pain sufferers. Through examining metabolites in cerebrospinal fluid (CSF), she was able to measure the alterations in flow caused by cerebellar tonsil herniations in Chiari patients. [“Cerebrospinal fluid is the window to understanding brain metabolism and its functions because the metabolites found in CSF are responsible for transferring nutrients as well as removing waste to and from the brain,”](#) said Dr. Shriver. Metabolomics, or the scientific study of analyzing important aspects of metabolism, can help one understand genetic and epigenetic controls, diet and medication processes, and protein modifications and regulations. Dr. Shriver ended her presentation by stating that global metabolomics is an extensive technological platform which can be used to examine transformations of energy, membrane physiology, and the relationship of inflammatory response to neuropathic pain.

Eye Manifestations in Chiari Malformations

Dr. Fatema Ghasia, an ophthalmologist at Cleveland Clinic, presented her findings on vision problems caused by the direct compression of the cerebellum and brainstem. By using high-precision video-oculography, ophthalmologists are able to examine and test the eyes for significant abnormalities. Generally, 80% of Chiari patients are diagnosed with ocular issues. “Conditions such as nystagmus [rapid involuntary movements of the eyes] and strabismus [abnormal alignment of the eyes] are the most common in Chiari patients. Nystagmus related problems are the most prevalent while strabismus affects a small amount of people with Chiari. Currently, there are only forty to fifty strabismus cases reported in medical literature. However, esotropia, which is a form of strabismus often associated with squinting, is known to predominantly affect children,” said Dr. Ghasia. She then explained that nystagmus and strabismus can typically be corrected by undergoing decompression surgery or sometimes—in the case of strabismus— strabismus corrective surgery. As with other research disciplines associated with Chiari, additional explorations in ophthalmology are needed to further Chiari awareness and understanding in the future.

Chiari Epidemiology

Dr. John Heiss, a neurosurgeon and the Residency Training Program Director of Neurological Surgery at the National Institute of Health, examined the history of Chiari and its present facts and statistics. Currently, there are a few diagnostic dilemmas associated with Chiari. Dr. Heiss reported that in 2009, a study was performed on a large pediatric population where Chiari effected fifty-one children out of 741,815—thirty-two of which were symptomatic while the nineteen remaining were asymptomatic. Some clinicians believe that Chiari malformation is a common, accidental MRI finding since many patients do not present with symptoms before undergoing a routine MRI. “When informing someone that they have a condition such as Chiari, it is always important to maintain a healthy doctor-patient relationship to help alleviate any anxieties patients may have after an initial diagnosis,” said Dr. Heiss. In the United States, more individuals are diagnosed with Chiari compared to anywhere else. Statistically speaking, women in the U.S. are 62-76% more likely to be diagnosed with Chiari compared to men (24-38%). Ethnic, genetic, and environmental factors can also determine Chiari malformation as well. Symptomatic patients often suffer from functional deficits as well as pain; therefore, most are advised to undergo decompression surgery. More outcome studies of symptomatic and asymptomatic patients are becoming present within the medical community which will help further many anticipated studies for Chiari malformation.

Measurements of CSF Flow in Pediatric Patients with Chiari

Dr. John Oshinski, an Associate Professor of Radiology and Biomedical Engineering at the Emory University School of Medicine and the Georgia Institute of Technology in Atlanta as well as the Director of Magnetic Resonance Research at Emory University, presented his findings on CSF flow in children with Chiari in contrast to adult patients. Since children have difficulties explaining symptoms themselves, Dr. Oshinski decided to examine the differences in CSF flow before and after decompression surgery. Forty pediatric patients diagnosed with Chiari were involved in his study; syringomyelia was present in seventeen of the forty children prior to decompression. Eight controls were also present to provide normal pediatric data for spinal fluid circulation. Dr. Oshinski noticed that the caudal (downward movement of CSF) flow was much higher in all of the children compared to the cephalad (upward movement of CSF) flow. After undergoing decompression, the speed of CSF flow did not change, but the circulation timing from the brain to the spinal cord drastically changed. In the future, Dr. Oshinski hopes to use additional types of pre- and post-surgery scans to better observe CSF flow and its additional dynamics. He also believes that utilizing a DENSE (Displacement Encoding with Stimulated Echo) MRI scan will improve and further enhance the collected results.

Voices of Chiari: Advancing Chiari Research through a National Patient Registry

Three members of NEOMED—Dr. Michelle Chyatte (Assistant Professor of Family and Community Medicine), Dr. Rebecca Fischbein (Assistant Professor of Family and Community Medicine), and Denise Kropp (Office of Research- Research Associate) — formulated additional ideas for an existing database to better assist Chiari patients and their families. The Conquer Chiari Patient Registry, originally designed by Rick Labuda, is freely advertised to patients as well as their respective caregivers in hopes of advancing Chiari-related research and understanding. As of April 22nd, 2014, 1,891 patients have submitted their data into the database; however, only 957 have diligently filled out all of the survey questionnaires. Of these 957, the majority of patients have Chiari I (80%) and are also predominantly female (81%). Additionally, most of the participants range from thirty-seven to fifty-four years old (38%) and were diagnosed between nineteen and fifty-four (50%). Headaches, neck pain, fatigue, numbness/tingling of the limbs, trouble sleeping, weakness, memory problems, issues with decision making, depression, and anxiety are a few of the top symptoms shared by patients in the database. Average tonsillar herniation was also recorded (9.4mm) for 316 patients. When Dr. Chyatte, Dr. Fischbein, and Ms. Kropp compared the collected data to current research studies, most of the findings were similar; however, the associated conditions and misdiagnosis data was not as comparable. Dr. Chyatte, Dr. Fischbein, and Ms. Kropp plan to create an interactive website and employ additional research topics and surveys such as treatment history, symptomatology, overall outcomes, and ethnographic investigation.

Diffusion Tensor Imaging in Chiari I Malformation

Dr. Andrea Poretti, a Pediatric Neuroradiology Research Associate at Johns Hopkins School of Medicine, reported on his study which utilized an advanced magnetic resonance technique, known as diffusion tensor imaging (DTI), to observe children with Chiari I. By using diffusion tensor imaging, Dr. Poretti and his team were able to accurately map large, anatomical changes in pediatric patients. Through tracking the movement of water in the brain, the DTI is able to generate virtual representations of white matter tracts on the brain. Since the researchers found decreased values of white matter, this further implied injury of the brain stem and cerebellum in children who were symptomatic as the team hypothesized. However, further studies are needed to assess additional information on the extent of compression and tissue alterations in Chiari I patients. DTI guidelines may also be utilized to monitor response to monitor treatments. In conclusion, Dr. Poretti stated that diffusion tensor imaging is an excellent tool to use for multiple forms of Chiari I analysis.

Poster Winners Announcement

Dr. Konstantin Slavin and Rick Labuda announced the top three student researchers who presented and described their studies to multiple attendees and judges at the Conquer Chiari Research Conference. The overall objective of this competition was to further advance the understanding of Chiari and syringomyelia to improve the experiences and outcomes of Chiari and syringomyelia patients. First, second, and third place winners received cash prizes of \$500, \$400, and \$300 respectively.

First Place: Soroush H. Pahlavian

Neural tissue motion impacts CSF dynamics at the cervical-medullary junction: a patient-specific computational fluid dynamics model

Second Place: Trevor Ham

Spinal cord injury treatments tested in vivo integrating neural stem cell delivery and lineage specification via immobilized growth factors

Third Place: Michael Majcher

Quantification of neural tissue deformation in type I Chiari malformation patients' pre- and post-spinal decompression surgery and comparison to controls

Spinal Canal Hydrodynamics of Chiari Patients: Importance of Geometry

Dr. Francis (Frank) Loth, the Executive Director of the Conquer Chiari Research Center, Director of the Biofluids Laboratory at the University of Akron and an Associate Professor in the Departments of Mechanical and Biomedical Engineering, presented his integrated geometric study on the hydrodynamics of cerebrospinal fluid flow. Dr. Loth stated that cerebellar tonsillar descent is not a good enough measurement to use to evaluate Chiari patients. Since the flow of CSF is tight and elevated, there is increased resistance and unsteady pressure in the spinal canal. To test his theory on CSF resistance caused by tonsillar herniation, fifteen Chiari patients were assessed before and after surgical decompression. Since MRIs are unable to detect the hindrance of CSF flow, the motion of the brain above the large opening of the cranium is not accounted for and therefore indicates that resistance is significantly higher before surgery. Dr. Loth then stated that multiple measures are needed in the future to calculate a patient's improvement after surgery. He also suggested a study of more patients which are matched by group demographics as well as segmented by comparable symptoms.

Understanding the Developmental and Psychoeducational Implications of Chiari Malformation: An Integrative Approach

Dr. Kevin Kaut, a professor in the Psychology Department at the University of Akron and a former school psychologist, reported his findings on how Chiari behaviorally and developmentally impacts children. Parents of young Chiari patients were asked to complete a developmental inventory which detailed prenatal and postnatal development as well as additional concerns. Most of the children enrolled in Dr. Kaut's study were enrolled in pre-k to 4th grade (51) while the rest were comprised of middle school and high school students (45). In the prenatal development period, 50.5% of mothers reported that they suffered from health complications which caused half of them to take pain relievers, prenatal vitamins, or psychotropic medications. When their delivery day came, 30% of mothers reported that their child or children experienced some form of distress during birth, such as trouble with breathing (75%). In the case of sensorimotor development parents expressed that as their child aged, the more problems they had physically interacting with their environment. 34% of parents also reported that their child had delays in their language development. Most children were diagnosed with Chiari between Pre-k and 4th grade (67%). Decompression surgery was also performed predominantly through pre-k and 4th grade or in high school. Somatic and behavioral manifestation concerns such as irritability, frustration, and fatigue were indicated by 89% of parents; however, when asked to rank educational performance, most parents claimed that their children were in the above average or average range. Quality of life was also thoroughly analyzed by Dr. Kaut and he discovered that as children aged, the more they suffered from pain as well as continually elevated their prescription drug use. However, he concluded that there is a silver lining to this study—more often than not, youngsters suffering from Chiari are resilient and do not let their diagnosis keep them from performing as best as they can.

Cognition in Chiari Malformation I: Impact of Herniation Level, Surgery, Mood, and Training

Dr. Maureen Lacy, an Associate Professor of Psychiatry, Behavioral Neurosciences, and Surgery at the University of Chicago Medical Center, psychologically evaluated 74 children diagnosed with Chiari in hopes of measuring the cognitive, behavioral, and emotional impacts associated with the condition. 41 males and 34 females were enrolled and most were diagnosed with Chiari around seven years of age. Prior to the study, half of Dr. Lacy's patients were decompressed, yet many still had cognitive and behavioral issues. Problems with memory and fine motor skills were the most prevalent throughout the study and could be directly linked to significant headaches as well as other forms of pain. Although the patients with and without surgery were evenly split, they didn't have any significant difference in cognition. However, some children expressed that they had anxiety (47%) and a few admitted that they felt depressed sometimes. Dr. Lacy concluded that most of the individuals in her study maintained a normal intellect with average cognitive abilities and those who had decompression surgery didn't have any evidence of negative impacts on their cognitive, behavioral, and emotional health.

Connexin 26 [Respiratory Physiology and Chiari I] / Chiari I: Constructing the Posterior Cranial Fossa

Dr. Georgy Koentges, a Professor of Systems Biomedicine and Evolution at the University of Warwick, detailed his expansive study on the genetic and anatomic origins of Chiari. In his first presentation, titled “Connexin 26 [Respiratory Physiology and Chiari I],” Dr. Koentges spoke of neural crest cells, which are responsible for giving rise to diverse forms of genetic lineage mutations. In early childhood, some individuals are affected by a localized anatomical defect within the cranium that eventually leads to childhood Chiari. The clivus, a backward sloping bone within the skull base, is thought to cause the structural defect if it doesn’t develop properly. Since neural crest cells are considered unknown to science because they cannot be fully studied or completely understood by researchers, their functions vary depending on their location. In relation to Chiari, Connexin 26 is essential for breathing. The cells start mutating three to four months after birth and continue to constantly [modify themselves throughout the lifetime of an individual](#). [“My greatest wish to you clinicians is if we can get enough Chiari patients together to test how they fair against age matched control populations. Is there a difference in the adult Chiari I population? If the answer is yes, then that aspect of their breathing can be explained as a neural crest disease,”](#) concluded Dr. Koentges.

His second presentation, titled “Chiari I: Constructing the Posterior Cranial Fossa,” covered the composition of the clivus in more detail. Dr. Koentges reported that the clivus has five ontogenetic parts which are supposed to close during the second or third decade of life; however, if defects are present and neural crest cells decide to invade the open space, the clivus continues to grow and develop—even if there is not enough space in the skull for it to expand. The same type of infiltration can also happen within the occipital bone which causes a bump near the bottom of the skull base (close to the cranio-cervical junction and cervical spine). An imbalance of estradiol and testosterone are said to cause the mutation. Dr. Koentges closed by stating that a new definition of cranio-cervical syndrome is needed based on fundamental biological classifications of Chiari I.

The Conquer Chiari Research Conference highlighted not only the exciting work going on in the research community, but also the tremendous progress Conquer Chiari has made in a short period of time. Many of the presentations were a result of Conquer Chiari funded projects, which of course, were made possible by the tireless efforts and generosity of our volunteers and donors.

The Conquer Chiari Research Center is planning another Open House event for patients, family members, and the community at large in the Spring of 2015. Many of the topics discussed at this conference will be presented at the Open House in an easy to understand format.

■ Jennifer Eubanks