CHIARI MALFORMATION PROGRAM

EDUCATION, TREATMENT & SUPPORT

www.mhsi.us  (877)784-3667
This booklet is not meant to substitute for the advice and counsel of your doctor. If you have any questions, please ask your doctor. Educational contents of this booklet have been provided in part by the American Syringomyelia and Chiari Alliance Project.
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### Education

**MD:** University of Michigan Medical School  
**Fellowships:** Peripheral Nerve Surgery at the Louisiana State University Medical Center, in New Orleans, LA Pediatric Neurosurgery at Children's Hospital of Michigan  
**Residency:** Neurological Surgery at the University of California, Davis Medical Center  
**Internship:** General Surgery at University of California, Davis Medical Center  
**AB:** Arts Bachelor’s in English, cum laude, Harvard University

### Prior Appointment

Assistant Professor of Neurosurgery, Wayne State University School of Medicine

### Certifications

Neurological Surgery and in Pediatric Neurological Surgery

### Membership

American Society for Pediatric Neurosurgery  
Peripheral Nerve Task Force (AANS/CNS)  
American Medical Association  
Michigan State Medical Society  
Wayne State Medical Society  
National Medical Association  
American Association of Neurological Surgeons  
Society for Neuro-Oncology  
Congress of Neurological Surgeons  
Women in Neurosurgery  
Detroit Medical Society  
Hydrocephalus Association

### Honors

FACTS ABOUT CHIARI

What is Chiari malformation?

Chiari malformation (CM) is a serious disease of the skull and brain in which brain tissue is pushed down into the neck. The part of the brain that is pushed down is called the cerebellar tonsils.

CM happens when the hole at the base of your skull, called the foramen magnum, is too small or has the wrong shape. The wrongly shaped skull base then presses on the brain and forces it downward. CM can block the flow of cerebro spinal fluid (CSF), which can cause the CSF-filled spaces in your brain to enlarge. This is a condition called hydrocephalus. Blocked CSF flow can also cause a fluid filled cyst, known as a syrinx, to form in the spinal cord. Pushed-down brain tissue can put extra pressure on the brain stem and spinal cord, causing many other problems in the brain, spinal cord and some other parts of the body.

CM also can be known as Arnold-Chiari malformation, tonsillar herniation or tonsillar ectopia.

Most cases of CM are congenital, meaning present since before birth. Although CM can develop after birth on rare occasion.

Kinds of Chiari malformations

There are four types of Chiari malformations:

Chiari I is the most common. It is often associated with syringomyelia (SM) and scoliosis. SM is a disease in which there is a syrinx, or fluid-filled cyst, in the spinal cord. Scoliosis is a curved spinal column, or backbone. CM I usually does not cause any problems during childhood. It typically begins to become a problem in the teen and adult years. When problems do begin, the first is usually a bad headache.

Chiari II is also called Arnold-Chiari syndrome. It is associated with myelomeningocele, a birth defect in which the spinal column does not close before birth. Myelomeningocele is a kind of spina bifida. CM II also is associated with hydrocephalus. It causes shifting of the brain stem and is commonly diagnosed when the patient is still a child.

Chiari III is a severe nervous system disease. CM III usually is connected with a disease in which a baby’s skull does not close completely before birth. Part of the baby's brain can then come through the openings in the skull. CM III is usually a terminal condition unless surgically treated.

Chiari IV is the least common type of CM and involves a lack of development of a portion of the base of the brain called the cerebellum.
SYMPTOMS AND DIAGNOSIS

Symptoms of Chiari

• headache caused or made worse by coughing, straining and sneezing, which are actions known as valsalva maneuvers.
• neck and shoulder pain
• balance issues that can make it difficult to walk
• poor control of body
• nausea
• dizziness
• nystagmus-side-to-side movements of the eyes
• change in the sound of your voice
• swallowing difficulties - hard time swallowing or often swallowing the wrong way
• facial pain
• tinnitus-ringing in the ears
• hearing difficulties - decreased hearing or “fullness” in the ears
• sleep apnea - pause in breathing during sleep
• insomnia - difficulty falling asleep and staying asleep
• heart palpitations - increased heart rate
• muscle weakness
• chronic fatigue
• painful tingling in the hands or feet
• central hypertension-high blood pressure due to Cushing’s reflex response

CM patients under the age of 3 most often have a problem controlling the area of the throat at the back of the mouth. This is called the oropharyngeal area. Problems in this area can make it hard to swallow and speak. These problems can lead to delayed speech development, excessive drooling and gagging.

A few common problems in CM patients over the age of 3 are curved spine, headache and neck pain. Poor body movement control and a strange sense of feeling also are possible.

Diagnosing Chiari malformation

There is no single, objective test to definitively say whether a patient has symptomatic Chiari. Magnetic Resonance Imaging (MRI) can show whether the cerebellum is crowding the spine, however, the final diagnosis is made through a combination of radiological imaging, reported symptoms, both present and past, and a neurological exam. Other tests also may be needed.

CM once was defined by the cerebellar tonsils being three to five millimeters or more below the foramen magnum. This is measured on an MRI. Research has shown that the size of the herniation is NOT strongly related to severity of symptoms. The size of the herniation also does not strongly relate to how well patients respond to treatment.

Those who study CM are looking for new ways to measure the impact of Chiari on a patient. Right now this research is focused on using advanced MRI and engineering tools.
TREATMENT AND SURGICAL OPTIONS

Treating Chiari malformation

The first step toward determining the best treatment for CM is a full exam by a Chiari specialist, usually a neurosurgeon. There is no single test or symptom that indicates if and when a patient should have surgery.

The factors the team thinks about in deciding whether or not to operate on a patient for CM, with or without syringomyelia (SM), are:

- whether or not the patient has hydrocephalus
- base of the skull has malformed bones (such as a basilar invagination)
- distorted cerebrospinal fluid (CSF) space at the foramen magnum
- instability of the cranio-cervical junction, at which the head and neck meet
- presence of SM and/or syringobulbia
- whether previous operations were performed
- patient’s quality of life

After a full exam, the Chiari specialist might choose a “wait and see” plan of action. Your health will be checked regularly and each symptom will be treated. Support care such as headache and pain management can help control symptoms. Physical therapy (PT) and change in activity may also help control symptoms.
Surgery is the only way to correct the underlying compression. This choice is based on whether symptoms are clearly due to CM or CM/SM, and bad enough to need surgery. The surgery was traditionally called a posterior fossa craniotomy, or back of skull opening. Today, the procedure is more often called Chiari decompression.

The neurosurgeon makes more room in the back of the head by removing small pieces of the skull bones. Part of the C1 vertebra may be cut out in a process also known as a laminectomy. The covering of the brain, or dura, will likely be opened and a patch of similar material sewn in to make the dura larger. Part of the cerebellar tonsils may be removed.

The intent of the operation is to return the CSF flow to as close to normal as possible. Return of good CSF flow should relieve symptoms. It should also take pressure off the brain stem and lead to shrinkage of any syrinx that might exist. Two additional goals of the surgery are to keep symptoms from getting worse and from coming back.

**What to expect from surgery**

Almost all surgeries for CM and SM happen in the prone (face down) position. The neurosurgeon clamps the skull in place to keep the surgery site very steady. This may cause the patient some pain at the sites (usually three) where the pins of the skull clamp press into the skin. The patient will not be aware of this clamp, since it is put on after the patient is asleep and taken off before the patient wakes from general anesthesia. The surgery takes about three hours.

The incision for Chiari surgery is from the lower part of the back of the skull to the upper part of the neck and straight down the middle. The procedure usually is quite painful due to muscle being pulled back and the cutting done to perform the surgery.

**Postoperative care in the hospital**

Surgery can be painful afterward and has some risks. The patient usually spends the first night in the intensive care unit (ICU). During this time, pain is usually the biggest issue and the patient is closely watched for neurological setbacks. Other risks include CSF leakage, pseudomeningocele, bleeding and infection. A pseudomeningocele occurs when CSF leaks from the spinal sac and builds up under the skin.

Nausea and vomiting the first day or two after surgery are possible due to anesthesia medicines and/or decompression of the fourth ventricle during surgery. The floor of the fourth ventricle is the seat of nausea. Some Chiari patients have compressed fourth ventricles with poor CSF flow before surgery. During Chiari decompression surgery the fourth ventricle is decompressed, restoring good CSF flow to the fourth ventricle, including the area that is the seat of nausea. This new stimulation to the floor of the fourth ventricle can trigger nausea for several hours, which eventually subsides. During the post-op hospital stay the patient will be monitored and if necessary treated for nausea.

After the first night in ICU, it is expected that the patient will be moved to a regular room. This will allow two or three days of care, pain control, and the first phase of recovery.

The first few days after surgery, pain medications and muscle relaxers are used...
to ease pain and discomfort. The patient and family need to realize the doctors are limited in the amount of pain medication they can provide. Too much pain medication could cause other setbacks and complications. For example, a patient who is overly drowsy due to too much pain medication can get pneumonia. Such a patient also does not get out of bed to walk, thus becoming prone to setbacks from too much bed rest. The doctors must carefully adjust the level of medication to balance the patient’s comfort with safety. It is important that the patient appreciates the balancing act the doctor does in deciding pain medicine doses.

**Postoperative care at home**

When the patients leave the hospital, they can plan on about six weeks of rest at home to recover.

After surgery, most neurological symptoms are expected to go away. Pain should subside in the first two to three weeks. Some patients have constant surgical pain that may last several weeks or months after surgery. They must be prepared for this.

During this time the patient should walk and get plenty of rest. However, the patient should refrain from athletics, strenuous exercise, lifting objects heavier than 5 pounds, work and school for the six weeks, or as determined by the doctor.

The patient may shower, but should avoid bathtubs, whirlpools and swimming pools until cleared by the doctor. Patients with Steri-Strips must cover the incision as directed by the doctor. The patient or caregiver may remove the tapes when directed. If tapes get wet, they can be patted dry or dried with a hair dryer on a cool setting. Once the patient is cleared to get the incision wet, gently scrub the incision to exfoliate, but do not scratch the incision.

The patient may resume driving when completely off narcotics and when head motion is good, as declared by the doctor.

**Prognosis for Chiari**

Researchers do not know the exact success rate for CM surgery. Up to 50 percent of CM patients become symptom free after surgery. Twenty to 30 percent improve, while 20 percent do not improve or get worse. Much of the patient’s result depends on the patient’s health and the presence of other conditions before surgery. After what can be a long recovery, many people lead a normal or near normal life. For those with lasting symptoms, some lifestyle changes may be needed as Chiari might be a constant condition. People whose first surgery fails often undergo another surgery, sometimes several. Unfortunately, symptoms can come back, even years after surgery.

Knowing the bones of the skull can regrow, especially in younger patients, our neurosurgeons believe in creating a more generous decompression the first time to better reduce the need for subsequent surgeries.
Related Disorders

A few diseases are sometimes linked with CM. Several are described in this section.

**Aseptic meningitis** - Inflammation of the linings of the brain and spinal cord and does not have a bacterial cause. This can occur after any surgery that requires the opening of the brain coverings. During surgery, some blood cells may enter the cerebral spinal fluid. After surgery, as these cells break down the products of cellular break down irritate the inside lining of the meninges. This can cause a headache and fever and is treated with steroid therapy.

**Basilar invagination** - This is when the upper end of the spine, or C2 vertebra, sticks into the skull. This puts harmful pressure on the brain stem.

**Connective tissue disorders** - Connective tissue supports many body parts, such as the skin, muscles and ligaments. When connective tissue is faulty, it is usually due to faulty collagen. Collagen is a protein that works like glue in the body. It makes connective tissue strong and stretchy. One of the connective tissue diseases that might be linked to CM is Ehlers-Danlos Syndrome (EDS).

EDS is a genetic disease that makes joints too mobile, skin too stretchy and tissue too fragile. There are six different types of EDS categorized by the symptoms they cause. Treatment includes physical and occupational therapy to learn how to avoid injury.

**Hydrocephalus** - This occurs when the ventricles of the brain hold too much cerebrospinal fluid (CSF). Treatment includes placing a shunt to drain the fluid.

**Intracranial hypertension** - This can also be known as pseudotumor cerebri, a condition characterized by CSF pressure in the brain always being too high. It can cause headache, nausea, vomiting and vision problems. The vision problems are due to optic nerve swelling. Optic nerve swelling can be found by an eye exam. A spinal tap measures pressure, but longer-term pressure monitoring may be needed. Surgery and a hospital stay are needed for pressure monitoring. Treatments include medical therapies to reduce CSF production or a shunt to drain CSF.

**Myelomeningocele** - A birth defect that occurs when the vertebrae do not fully form and remain open allowing the spinal cord to protrude. The condition is also known as a type of spina bifida. Surgical repair is usually required.

**Neuropathic pain syndrome** - Patients experiencing pain caused by damage to the central nervous system are said to have neuropathic pain syndrome. The symptoms are burning pain and abnormal feelings. Neuropathic pain syndrome is hard to treat, but responds best to medication that treats neuropathic pain.

**Scoliosis** - Scoliosis, a side-to-side curving of the spine, is one of the most common first symptoms in pediatric Chiari patients over 3 years old. Early and quick treatment of CM in a child with fast progressing scoliosis can halt progress of the spine curving. These children also should have an MRI of the spine to assist in ruling out syringomyelia (SM), which may cause scoliosis.
Spina bifida - When a person is born with a spinal canal that did not close during development, he or she is said to have spina bifida. There are many different types of spina bifida, ranging from spina bifida occulta, which is benign, to myelomeningocele, which is severe. Most patients with myelomeningocele will have Chiari II.

Syringobulbia - This is a syrinx, or cyst, in the brain stem, which is a part of the brain.

Syringomyelia (SM) - This is a disease in which there is a syrinx, or cyst, in the spinal cord. See Syringomyelia chapter of this handbook for more information.

Tethered Spinal Cord Syndrome - This is a disorder in which the spinal cord is abnormally attached to a structure within the spine and is causing harmful traction on the spinal cord. See the Tethered Spinal Cord Syndrome chapter of this handbook for more information.

Syringomyelia

Syringomyelia (SM) is a disease in which there is a syrinx, or cyst, in the spinal cord. The syrinx is filled with cerebrospinal fluid (CSF). Due to normal activities like coughing and straining, SM cavities can slowly become larger over a period of time, often years. As the syrinx gets larger, it stretches the spinal cord and damages nerve tissue. Damage to nerve tissue can result in serious and/or disabling symptoms. Syringomyelia can also be known as hydromyelia.

CM causes most cases of SM. Up to 50 percent of CM patients also develop SM. CM can block the normal flow of CSF, which forces the fluid into the spinal cord, creating the fluid filled syrinx.

Types of syringomyelia
The type of SM a patient has depends on the cause. There are two main types:

- those caused by Chiari
- those caused by disease of the spine

Birth defects, tumors, injuries, infections or past surgeries are the most common causes of these diseases of the spine. Past spine surgery can cause SM due to the growth of too much scar tissue. There also is a small chance that SM can be caused by placing a foreign liquid in the spinal canal.

Symptoms of syringomyelia
Symptoms of SM usually happen slowly over time. However, a fall or minor trauma can make the symptoms of SM appear more quickly.

Motor symptoms

- weak and shrinking muscles, mostly in hands and arms
- stiff and spastic muscle tone in arms and/or legs
- abnormal curvature of the spine (scoliosis)

Sensory symptoms

- decreased feeling in hands and arms, with the legs possibly being affected depending on size and place of the syrinx cavity
- exaggerated sensation (hypersensitivity) in limbs, mostly in the arms
Pain symptoms
- midline pain over the spine, particularly the trunk area
- burning pain in arms, over trunk and, rarely, legs
- joint pain, usually in the shoulders

Sphincter problems
- total or partial loss of bladder control, sometimes a spastic feeling of the bladder
- total or partial loss of bowel control
- male impotence

Symptoms of involuntary body functions
(body functions our brain controls without us thinking about it, such as breathing)
- wide swings in blood pressure, often accompanied by profuse upper body sweating, both involuntary body functions collectively known as dysreflexia
- drooping of one eyelid
- fainting or nearly fainting, a rare condition called syncope
- commonly worse on one side of the body.

Diagnosing syringomyelia
MRI can clearly show the presence of a syrinx in the spinal cord. A neurological exam is used to decide the impact the syrinx is having on the nervous system.

Surgery for syringomyelia
If CM is thought to be the cause of the SM, neurosurgeons most often will do a Chiari decompression surgery, then watch to see if that brings about a collapse of the syrinx. If the Chiari surgery does not collapse the syrinx, the patient might need surgery for the syrinx. The incision for a syrinx can be at any point in the back of the neck or upper back. It depends on the location of the syrinx cavity.

Prognosis for syringomyelia
Researchers do not have exact data on the prognosis for syringomyelia. Much depends on the patient's health and the presence of other conditions before surgery. Up to 80 percent of patients will experience some level of relief or at least not get worse. About 20 percent will get worse.

Most patients will have some lasting symptoms even after surgery, so major lifestyle changes may be needed. Severe, constant pain, which can be difficult to treat, is one of the most common long-term problems. Recovery can be very slow and can involve many setbacks. Living with SM can have a major effect on patients and their families.

Tethered spinal cord syndrome
Tethered spinal cord syndrome (TC) is a disorder that occurs when the spinal cord is abnormally attached to the spine by any of the following structures:
- dura
- scar tissue from a previous operation
- bony spicule
- tumor

Due to the abnormal attachment, movement of the spinal cord within the spinal column is limited because of unwanted and often painful stretching of the spinal cord. Although most cases are congenital, which means you are born with it, the condition may not become symptomatic until later in life when the cord continues to grow and lengthen. Tethered cord is found most often in patients with spina bifida, although it is frequently associated with Chiari malformation.

TC can affect people of all ages, but it is most often found in people ranging from infancy
to teen. Symptoms of tethered cord become more pronounced during periods of rapid growth due to increased stretching of the spinal cord.

**Signs and symptoms of tethered cord syndrome**

Each individual will experience a unique set of symptoms which may also change as the patient ages.

Common symptoms in children:
- fatty tumor or deep dimple on the lower back
- skin discoloration on the lower back
- hairy patch on the lower back
- scoliosis (curvature of the spine)
- bowel and bladder problems
- leg numbness or tingling
- changes in leg strength
- deterioration in gait
- progressive or repeated muscle contractions, or spasms
- leg and foot deformities

**Common symptoms in older children and adults:**
- back pain, worsened by activity and relieved with rest
- leg pain, especially in the back of legs
- weakness in the lower extremities and/or fatigue with walking
- recurrent bladder infections
- urinary hesitancy, increased frequency and increased urgency
- urinary or fecal accidents

Tethered cord can be difficult to diagnose in babies and children because the symptoms may be subtle and deceptive at times. For example, the most common symptoms of TC -like back pain, abnormal gait and urinary accidents-are frequently attributed to other causes during childhood. Patients with untreated tethered cord will continue to experience their current symptoms, and their motor and sensory function may worsen. Particularly in children, lengthening of the spine with growth can lead to paraplegia and loss of bowel and bladder function. Chronic back and leg pain in children is not common and should not be taken lightly.

**Diagnosing tethered cord**

A spinal MRI is obtained to confirm the diagnosis and presence of a tethered cord at any age.

**Treating tethered cord**

If the patient primarily has back pain and mild weakness, a course of physical therapy may provide tethered cord treatment and relief. This approach requires the patient to be old enough to reliably convey whether the symptoms are worsening or improving as their therapy progresses.

In most cases, surgical treatment of tethered cord is needed to prevent neurologic deterioration. A laminectomy is performed, in which the dura is opened and using the operating microscope, the spinal cord is freed from the tethering structure. If possible, the tethering object is removed. If the object stuck to the cord is a bony spicule or tumor, it is removed in an attempt to avoid re-tethering, which can often happen.

Recovery from the surgery is two to six weeks of very limited activity to ensure proper healing of the surgical site and to prevent leaking of any cerebrospinal fluid. Most patients are not required to undergo physical therapy post-operatively. Many patients regain normal function following surgery and recovery.
# RESOURCES AND NOTES

## My Chiari team

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Patient question form

Below are three questions you may want to ask your doctor. Please use this form to help you better understand your diagnosis and plan of treatment. There also is space for any other information you may need when speaking with your clinicians. Feel free to add your own questions as well.

1. What is my diagnosis?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

2. What do I need to do next?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

3. Why are these next steps important?

_______________________________________________________________________
_______________________________________________________________________
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4. _______________________________________________________________________
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5. _______________________________________________________________________
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Three keys to understanding Chiari

Each person’s Chiari is unique, and no one else can completely understand what you are going through. Look for acceptance within yourself.

Some questions have no immediate answer. Don’t spend a lot of time searching for absolute explanations.

You can take control or be controlled. It is your choice. Take action, ask questions, educate yourself and trust your instincts.

Websites you may find informative and helpful:

www.conquerchiari.org     www.asap.org
Your child’s educational needs

School is the center of a child’s world. For children with special healthcare needs, their educational experience often is affected. Some common educational concerns include:

- frequent/intermittent absence
- mild to moderate learning difficulties
- distractibility
- loss of instructional time due to inflexible home instruction policies
- health services needed at school (medication, monitoring)
- decreased stamina
- Stress over schoolwork
- difficulty “catching up”
- social isolation

School re-entry is an important part of the recovery process for children and teens. Whether at home or in school, a return to class work is a big step forward.

Although school policies vary from state to state, there are federal regulations and statutes that provide accommodations and services for children and teens with special health care needs at school. Some of these are:

- Section 504 of the Rehabilitation Act of 1973
- Individuals with Disabilities Education Act (IDEA 2004)
- Americans with Disabilities Act of 1990

To learn more, speak with your school principal or refer to the Internet resources on the following page.
Educational/psychological testing for children

What is a pediatric psychology evaluation?

A pediatric psychology evaluation includes assessment of your child’s functioning across multiple domains - intellect, memory, attention, school achievement, behavioral/emotional/social development and coping skills. The evaluation typically takes three to four hours and can be completed in one or more sessions, depending on your child’s needs. Most children find the evaluation interesting and fun. We recommend testing through your child’s school district or a neuropsychologist.

What are the benefits of a pediatric psychology evaluation?

Results from the evaluation serve many purposes. If obtained early in the treatment process (baseline), it provides a measure from which to monitor your child’s functioning over time. This enables your child’s doctors to understand the impact of treatment on your child’s cognitive functioning and quality of life. Results also can be useful to develop appropriate educational plans for your child at school. These evaluations also will identify areas that may require specific intervention. As such, a list of recommendations will be offered in the report. Your child’s progress can then be monitored with follow-up evaluations.

Will my insurance cover the cost of the pediatric psychology evaluation?

Most insurance companies cover the costs of these evaluations given your child’s medical condition. We will assist you in obtaining pre-authorization for this service.

How do I know if my child should have a pediatric psychology evaluation?

Due to the invasive nature of Chiari surgery, if your child has a history of educational difficulties it is recommended that your child be evaluated. You should discuss this evaluation with your child's doctors.

Information provided by Chiari Institute of Long island

Other resources

Council for Exceptional Children
www.cec.sped.org

IDEA information (Individuals with Disabilities Education Act)
www.idea-practices.gov (now connected with CEC above)

IDEA archives
www.ed.gov/idea

National Center for Learning Disabilities (NCLD)
www.nclld.org

Parent Advocacy Center for Educational Rights
www.pacer.org

United States Department of Education
www.ed.gov

Office of Special Education and Rehabilitation Services
www.ed.gov/about/offices/list/osers

Office of Special Education Policy
www.ed.gov/about/offices/list/osers/osep

A Guide to the Individual Education Program
www.ed.gov/print/parents/needs/speced/iepguide

Wrightslaw Advocacy Site
www.wrightslaw.com
**Glossary**

**Apnea**
A condition where one temporarily stops breathing.

**Arachnoiditis** *(a-rak-noy-die-tis)*
An inflammation of one of the layers of brain covering.

**Basilar Invagination**
When the top of the C2 vertebrae moves upward, causing the opening in the skull base to narrow.

**Brain stem**
The part of the brain just above the spinal cord.

**Cerebellar tonsils**
Rounded extensions of the underside of each side of the cerebellum.

**Cerebellum**
The lower back part of the brain.

**Cerebrospinal fluid** *(suh-ree-bro-spine-uhl)*
Clear fluid that surrounds the brain and spinal cord.

**Chiari malformation** *(key-ahr-ee)*
Condition in which brain tissue is pushed down into your spinal canal.

**Clinician**
A doctor, nurse or healthcare practitioner having direct contact with and responsibility for patients.

**Collagen** *(kol-uh-jun)*
A protein which works like glue in the body to make connective tissue strong and stretchy.

**Compression**
A reduction in space that causes an increase in pressure.

**Congenital** *(con-gen-i-tal)*
When a condition is present at/since birth.

**Connective Tissue**
Tissue that connects, supports, or surrounds other tissues and organs.

**Constipation**
Infrequent or difficult emptying of the bowels, with hard feces.

**Cranio-cervical junction** *(kray-nee-oh-sir-vic-al)*
Where the skull and the neck come together.

**Decompression**
Surgery to relieve a condition where a structure is being compressed.

**Dura**
Outermost of the three layers that cover the brain and spinal cord.

**Dysreflexia** *(dis-ree-flex-ia)*
Wide swings in blood pressure, often accompanied by profuse upper body sweating.

**Ectopia** *(ek-toh-pee-uh)*
Displacement of an organ or part of an organ since time of birth.

**Ehlers-Danlos syndrome** *(ee-lers dan-lohs)*
A group of inherited tissue disorders which cause the body to produce faulty collagen.

**Fatigue**
Tiredness from bodily or mental exertion.

**Filum**
A slender, threadlike extension of the bottom of the spinal cord.

**Foramen magnum**
The opening at the base of the skull.

**General anesthesia** *(an-us-thee-zhuh)*
A state of total unconsciousness resulting from anesthetic drugs.
Hereditary
Passing, or capable of passing, naturally from parent to offspring through the genes.

Herniation (her-nee-ay-shun)
To protrude abnormally from an area of the body.

Hydrocephalus (hy-droh-cef-a-lus)
Accumulation of cerebrospinal fluid within the cranium due to blockage of the proper movement of fluid, often causing enlargement of the head.

Hydromyelia (hy-droh-my-ee-lee-uh)
An expansion of the central canal of the spinal cord caused by an increase of cerebrospinal fluid. May also be called syringohydromyelia.

Hypersensitivity
An increase in a person’s sensitivity to light, sound, smell, taste, touch, temperature, and balance.

ICU
Intensive Care Unit. A hospital unit that includes special equipment and skilled personnel for the care of seriously ill patients requiring immediate and continuous attention.

Incision
A cut into a body tissue or organ made during surgery.

Insomnia
The inability to obtain an adequate amount or quality of sleep. The difficulty can be in falling asleep, remaining asleep, or both.

Intracranial hypertension (in-tra-crane-ee-uhl hy-per-ten-shun)
A rise in the pressure inside the skull that can result from or cause brain injury. Can also be known as Pseudotumor Cerebri.

Involuntary body functions
Body functions our brain controls without us thinking about them, such as breathing.

Laminectomy (lam-in-ect-oh-me)
Surgical removal of part of the vertebral bone called the lamina, which is the back part of the vertebral bone.

Laxative
A food or drug that stimulates the emptying of the bowels.

Magnetic Resonance Imaging (MRI)
A test used to examine the brain and other parts of the body using non-harmful magnetic field and radio waves.

Myelomeningocele (my-el-oh-men-in-joe-seal)
A congenital defect of the nervous system in which a sac containing part of the spinal cord and its coverings protrude through a gap in the vertebral column.

Neurological
Of or relating to the nervous system.

Neuropathic pain (neur-oh-path-ick)
Disease of the nervous system.

Neuroscience
Any of the sciences that deal with the structure or function of the nervous system and brain.

Neurosurgeon
Someone who does surgery on the nervous system (especially the brain).

Nystagmus (nis-tag-mus)
Rapid side to side movements of the eyes which cannot be voluntarily controlled.

Oropharyngeal (or-oh-fuh-rin-jee-uhl)
The area of the throat at the back of the mouth.

Palpitations
A noticeably rapid, strong, or irregular heartbeat due to agitation, exertion, or illness.
**Pediatric**
The branch of medicine that deals with the care of infants and children and the treatment of their diseases.

**Pediatrician**
A physician who specializes in the care and treatment of infants and children.

**Pneumonia** (new-mohn-ya)
inflammation of the lungs with congestion.

**Posterior fossa craniotomy**
(fos-uh cray-nee-ot-o-me) Surgical removal of part of the lower back of the skull.

**Prognosis**
A prediction of the likely course of a disease or ailment.

**Prone**
Lying flat face-down or on the stomach.

**Pseudomeningocele** (soo-doh-men-in-jo-seal)
An abnormal collection of cerebrospinal fluid.

**Pseudotumor cerebri**
( soo-doh-too-moh r shiroe-bri) Increased pressure within the brain in the absence of a tumor. Can also be called idiopathic intracranial hypertension (IIH).

**Radiological**
Relating to the branch of medicine that deals with the use of radiant energy in diagnosis and treatment of disease.

**Scoliosis**
Abnormal side to side curvature of the spine.

**Spastic**
Abnormally high muscle tone.

**Sphincter** (sfink-ter)
A ring of muscle surrounding and serving to guard or close an opening or tube, such as the anus or the bladder.

**Spina Bifida**
When a person is born with a spinal canal that did not fully close during development.

**Spina bifida occulta**
(spine-uh-bif-i-duh uh-cult-uh)
When a person is born with a spina bifida malformation which is causing no serious harm.

**Spinal canal**
The space in vertebrae through which the spinal cord passes.

**Spinal column**
A series of bones called vertebrae stacked one upon another. Can also be called the backbone.

**Syncope** (sing-kuh-pee)
Fainting.

**Syringobulbia** (sy-rin-go-bul-bi-a)
A syrinx, or cyst, in the brain stem.

**Syringomyelia** (sy-rin-go-my-ee-lee-uh)
A syrinx, or cyst in the spinal cord.

**Syrinx** (seer-inks)
A cerebrospinal fluid filled cyst.

**Terminal**
Causing, ending in, or approaching death; fatal.

**Tethered cord**
When the spinal cord is attached to its coverings and scarred.

**Tinnitus** (tin-eye-tis)
The perception of sound in your head when no outside sound is present. Can be known as ringing in the ears, but it is not always a ringing sound.

**Valsalva**
Forcibly exhaling against a closed airway. For example, coughing, sneezing or straining to have a bowel movement.

**Ventricles**
A connected network of cavities in the brain filled with cerebrospinal fluid (CSF).
MHSI is the largest, most experienced group of physicians in Southeast Michigan dedicated to treating patients with disorders of the head and spine. Our health care professionals are specialized in:

- Neurosurgery
- Interventional & non-interventional Physiatry
- Neurology
- Neuropsychology
- Physical Medicine & Rehabilitation

This prestigious team has pioneered the use of state-of-the-art technologies in treating tumors, fractures, trauma and serious diseases. Many are recognized nationally and internationally for their achievements in endoscopic surgery, radio-surgery, laser surgery, minimally invasive treatments and surgeries, and other advanced techniques.