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1.1 BIO-PHYSICAL INVESTIGATION

Biophysics is the science dealing with the application of physical methods and theories to biological mechanisms[1]. It is actually the intermingled science that uses the methods of physical science to study. Studies included under the branches of biophysics are all levels of biological organization from the molecular scale to whole organisms and ecosystems. Biophysical research shares significant overlap with biochemistry, nanotechnology, bioengineering, agrophysics and systems pertaining to biology.

Molecular biophysics generally relates to biological knowledge that is similar to those in biochemistry and molecular biology[2], but the queries are approached quantitatively. Scientists in this field conduct research concerned with understanding the interactions between the various systems of a cell, including the interactions between DNA, RNA and protein biosynthesis[3], as well as how these interactions are regulated. A great variety of techniques is used to answer these questions. The aim of Molecular Biophysics is to explain biological mechanisms in terms of the physical and chemical properties of participating ions and molecules.

This rapidly evolving field emerges from the rich interactions that have developed among the traditional areas of chemistry, biology, physics, genetics, computer science, and others. Molecular Biophysics is the integration of varied disciplines towards greater understanding of living matter. Research combine in novel ways the power of modern spectroscopic methods and computational approaches to reveal the determinants of self-assembly in biological systems.

Some biophysicists of chemistry and structural biology, to probe the physical bases for molecular recognition and guide the design of new and better drugs to treat fatal diseases. Others yet focus on fundamental aspects of solution thermodynamics and refine the description of biological macromolecules in their cellular environment. Fluorescent imaging techniques, as well as electron microscopy, x-ray crystallography,
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NMR spectroscopy[4] and atomic force microscopy (AFM) are often used to visualize structures of biological significance. Molecular biophysicists often consider complex biological events as systems of interacting units which can be understood through statistical mechanics, thermodynamics and chemical kinetics. By drawing knowledge and experimental techniques from a wide variety of disciplines, biophysicists are often able to directly observe, model or even manipulate the structures and interactions of individual molecules or complexes of molecules.

In addition to traditional (i.e. molecular and cellular) biophysical topics like structural biology or enzyme kinetics, modern biophysics encompasses an extraordinarily broad range of research, from bioelectronics to quantum biology. It is becoming very common for biophysicists to apply the models and experimental techniques derived from physics, as well as mathematics and statistics, to larger systems such as tissues, organs, populations and ecosystems. Biophysics combines the fields of molecular biology, biochemistry, chemistry, computer science, mathematics, medicine, pharmacology, physiology, physics and neuroscience.

**Biology and molecular biology**—Almost all forms of biophysics efforts are included in some biology.

- **Bioinformatics**—sequence alignment, structural alignment, protein structure prediction
- **Mathematics**—graph/network theory, population modeling, dynamical systems, phylogenetics.
- **Medicine and neuroscience**—tackling neural networks experimentally (brain slicing) as well as theoretically (computer models), membrane permitivity, gene therapy, understanding tumors.
- **Physics**—biomolecular free energy, stochastic processes, covering dynamics.
**NMR spectroscopy**, giving information about the exact structure of biological molecules, as well as on dynamics.

- **Fourier transforms infrared spectroscopy and Laser Raman spectroscopy** for procuring structural information about the subtle changes occurring at the molecular level.

**UV absorption spectroscopic technique for** the examination of the concentration of the protein molecules.

- **X-ray crystallography**, another method to gain access to the exact structure of molecules with atomic resolution

Many biophysical techniques are unique to this field. Research efforts in biophysics are often initiated by scientists who were traditional physicists, chemists, and biologists by training.

Biophysical techniques are methods used for gaining information about biological systems on an atomic or molecular level. They overlap with methods from other branches of science.

Biophysical chemistry[5] is a relatively new branch of chemistry that covers a broad spectrum of research activities involving biological systems. The most common feature of the research in this subject is to seek explanation of the various phenomena in biological systems in terms of either the molecules that make up the system or the supramolecular structure of these systems.

Biophysical chemists employ various techniques used in physical chemistry to probe the structure of biological systems. These techniques include spectroscopic methods like nuclear magnetic resonance (NMR) and X-ray diffraction. For example, the work for which Nobel Prize was awarded in 2009 to three chemists was based on x-ray diffraction studies of ribosome. Molecular biophysics[2] is a rapidly evolving
interdisciplinary area of research that combines concepts in physics, chemistry, engineering, mathematics and biology. It seeks to understand bimolecular systems and explain biological function in terms of molecular structure, structural organization, and dynamic behavior at various levels of complexity (from single molecules to supramolecular structures, viruses and small living systems). The technical challenges are formidable, and the discipline has required development of specialized equipment and procedures capable of imaging and manipulating minute living structures as well as novel experimental approaches.

1.2 PARALYSIS

Paralysis could be one of the most terrible conditions that a human body can be affected. A paralyzed person loses the capacity of voluntary movement in some part of the body, like the hands, legs or torso and hence becomes an invalid. The most terrible aspect of paralysis is when the person has to become overly dependent on someone else to accomplish the most routine of tasks.

Minor paralysis can be treated and the person can become healthy again (in this case it means that the person can move all his or her body parts in a normal manner again). But treatment of major paralysis, such as loss of movement in the hands, legs or the whole torso, can be a very long process. It might require a lot of cooperation from the patient as well as the family members. Some people afflicted with paralysis remained paralyzed all through tissue and muscle wasting can cause irreparable damage to the body.

Paralysis is defined as the loss of muscle movement and coordination in some part of the body. The loss of movement of muscles occur in systems of muscles, such as hand muscles, leg muscles, facial muscles etc. leading to paralysis in that particular region.
The loss of voluntary muscle movement is accompanied by numbness, or loss of sensation, in the affected part. Due to this, the person does not feel any pain or climatic changes like heat, cold, etc. in the paralyzed part of the body.

After some time, due to paralysis, the circulation and other metabolic activities of the affected part may come to a stop. This could cause disuse atrophy (weakness or the lack of blood), which could change the shape of the affected part. Prolonged disuse permanently, even after the condition of paralysis is treated.

Ayurveda regards pakshavadha as a vataja, i.e. a disorder caused due to imbalance of the vata, the air element of the human body. Vata dosha is responsible for the proper coordination of all voluntary movements in the human body. A block in the proper movement of the vatadosha can bring about pakshavadha in the person and the other definition of paralysis is defined as “The loss or impairment of motor function in a part due to lesion of the neural or muscular mechanism”.

Paralysis is loss of muscle function for one or more muscle. Paralysis can be accompanied by a loss of feeling (sensory loss) in the affected area if there is sensory damage as well as motor. Paralysis is most often caused by damage in the nervous system, specially the spinal cord. Other major causes are stroke, trauma with nerve injury etc. Drugs that interfere with nerve function such as curare can also cause paralysis. There are many known causes for paralysis and perhaps more yet to be discovered.

Depending on where the paralysis has occurred, it can be classified in the following types:

- Monoplegia, in which only one limb-hand or leg is affected,
- Paraplegia, in which both the trunk and the legs are affected,
- Hemiplegia, in which only one side of the body is affected,
- Quadriplegia, in which the trunk and all the four limbs are affected.

We will discuss in details only hemiplegia and paraplegia.
Paralysis could be localized, or it may follow a certain pattern. Most paralysis caused by nervous system damage (i.e. spinal cord injury) are constant in nature; however there are form of periodic paralysis, including sleep paralysis, which are caused by other factors.

Shoulder pain[6] is a common complication in hemiplegic and spinal cord injury patient. Shoulder pain is a major and frequent complication for individual with hemiplegic and spinal cord injury.

The paralysis is perpetuated in suggestible may be the development of an historical element, which has been produced by suggestion and which can be removed by psychotherapy[7]. In such a case the paralysis remains complete.

Paralysis is always caused due to the impairment of the central nervous system, i.e. the brain and the spinal cord or due to the impairment of the peripheral nervous system, i.e. the system of nerves radiating outwards from the brain and spinal cord. The followings are the reasons why these nerve impairments might take place, leading to paralysis:

1. **Strokes**: Strokes are the leading cause of paralysis. Strokes are the sudden loss of function of a particular portion of the brain. Hence, the brain is not able to send reflexes or receive stimuli from the corresponding nerves. Usually strokes can cause the paralysis of arms and legs, but the torso is not affected. Further, the stroke itself can be caused due to the loss of blood supply to the brain. The causes for this erroneous blood supply are:

   - Atherosclerosis, which may result in clogging of the blood vessel carrying blood to the cranial region.
   - Hemorrhage, which may be the rupturing of a blood vessel carrying blood to brain.
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Hypertension, which increases blood pressure and makes it more difficult for blood to reach the brain.

- Diabetes, which also increases blood pressure and makes it difficult for blood to reach the brain.

2. **Tumors**: Tumors in the brain or the spinal region can cause pressure to be exerted on the blood vessels to these regions. Consequently, the blood supply to the brain and/or the spinal cord reduces, which may cause paralysis.

3. **Trauma**: Trauma refers to direct injuries. These injuries could result into internal bleeding (hemorrhage), which would reduce the blood supply to the central nervous supply. Direct falls on the head or fracture of the vertebral column could cause such traumas.

4. **Multiple Sclerosis**: Multiple sclerosis is a chronic ailment that causes the damage to the mucilaginous sheath that covers the nuclear sheath. Due to this the sensory and motor nerves are damages and are not able to carry impulses and bring back responses to particular parts of the body.

5. **Cerebral Palsy**: Cerebral palsy is a condition that occurs in babies during their birth. If their central nervous system is impaired either during or shortly after their birth, then their coordination becomes faulty, leading to paralysis.

   Cerebral palsy (CP) is an umbrella term encompassing a group of non-progressive[8], non-contagious motor conditions that cause physical disability in human development, chiefly in the various areas of body movement[9].

   *Cerebral* refers to the cerebrum, which is the affected area of the brain (although the disorder most likely involves connections between the cortex and other parts of the brain such as the cerebellum), and *palsy* refers to disorder of movement. However, "paralytic disorders" are not cerebral palsy the condition of quadriplegia.
The signs of cerebral palsy differ from person to person and may change over time. Signs of cerebral palsy may include the following:

- Child is slow to reach developmental milestones such as learning to roll over, sit up, smile, or walk,
- Weakness in one (hemiplegia) or more limbs (arms or legs),
- Standing and walking on tiptoe,
- Difficulty with fine motor tasks (such as writing or using scissors),
- Difficulty maintaining balance,
- Walking with an abnormal gait, with one foot or leg dragging,
- Involuntary movements.

Spastic CP is classified by topography dependent on the region of the body affected; these include:

- Spastic hemiplegia is one side being affected. Generally, injury to muscle-nerves controlled by the brain's left side will cause a right body deficit, and vice versa. Typically, people that have spastic hemiplegia are the most ambulatory of all the forms, although they generally have dynamic equinus (a limping instability) on the affected side and are primarily prescribed ankle-foot orthoses to prevent said equinus[10].
- Spastic diplegia is the lower extremities affected, with little to no upper-body spasticity. The most common form of the spastic forms (70-80% of known cases), most people with spastic diplegia are fully ambulatory, but are "tight" and have a scissors gait. Flexed knees and hips to varying degrees, and moderate to severe adduction (stemming from tight adductor muscles and comparatively weak abductor muscles), are present. Gait analysis is often done in early life on a semi-regular basis, and assistive devices are often provided like walkers, crutches or canes; any ankle-foot orthotics provided usually goes on both legs rather than just...
one. In addition, these individuals are often nearsighted. The intelligence of a person with spastic diplegia is unaffected by the condition. Over time, the effects of the spasticity sometimes produce hip problems and dislocations. In three quarters of spastic diplegics, also strabismus (crossed eyes) can be present as well.

Spastic monoplegia is one single limb being affected,

- Spastic triplegia is three limbs being affected,
- Spastic quadriplegia is all four limbs more or less equally affected. People with spastic quadriplegia are least likely to be able to walk, or if they can, to desire to walk, because their muscles are too tight and it is too much of an effort to do so.

In addition, there are the following conditions which pertain to the malfunctioning of the spinal cord:-

1. **Slipped Disk or Herniated Disk**

   This happens when the vertebra of the backbone get dislocated. The fractured vertebra could cause an injury to the spinal cord, thus making the portion of the spinal cord permanently impaired.

2. **Neurodegenerative Diseases**

   The neurodegenerative diseases are several conditions that cause serious and permanent impairment of the nerves of the spinal cord (or the brain). These diseases are also associated with loss of memory.

3. **Spondolysis**

   Spondolysis is the medical term to the pain and stiffness in the joints of the vertebral column. This condition can cause impairment of the spinal cord.

   The above is not a complete list, for there are much too many conditions that can cause paralysis. However, the above are the common causative factors.
Paralysis is very easily diagnosable because its symptoms are too apparent. The following are the common symptoms of paralysis:

The person cannot feel it when something touches him/her or even when someone else touches him/her. The person also cannot feel pain in the affected part. In fact, it has been said that the most painful aspect of paralysis is the painlessness. Numbness to weather is common. The person cannot feel heat or cold. There could be tingling sensations in the unaffected parts of the body. There is generally an impairment of vision. The person becomes incontinent.

If paralysis lasts for a long time, then the biggest danger is that of the ‘death’ of the affected part. Due to the constant depletion of blood from the affected part, the part may become seriously damaged. As a result the muscles and tissues in that part will also get wasted, leading to disuse atrophy, as mentioned earlier. In quadriplegia, the most serious form of paralysis, the person’s body becomes like ‘skin and bones’ within a few months of the affliction.

Speech impairment is also a very common byproduct of paralysis. Along with speech impairment, there could be loss of auditory senses and visual senses as well. If the person is paralyzed on one side of the body (Hemiplegia) then there is a great chance that the eye on that side would lose its power of sight.

There is no danger of transmission of paralysis from one person to another as this is not an infectious condition. Paralysis is caused due to impairment of a person’s nervous system, and that is an internal problem of the human body.

The diet provided for people with paralysis must be a vata pacifying diet. For balancing the vata, the following guidelines must be followed:

- Warm foods are preferable to cold foods. Eat food when it is freshly cooked,
- Sweet, sour and salty are the tastes that are good for creating a balance of the vata. Avoid foods that are bitter, pungent and astringent in taste,
Nuts are very good for balancing the vata,

- Rice and wheat both are okay, but barley, millet and rye must be avoided,

- The fruits that you consume must be the juicier ones such as bananas, mangoes, oranges, etc. Dry fruits such as apples, figs, pears and pomegranates must be avoided,

- Asparagus, okra, beet, carrot are the vegetables that must become an important part of the daily diet,

- Among the meats, white meats such as poultry and fish are much better as compared to red meats such as beef, pork and mutton.

Now we will discuss in details only Hemiplegia and Paraplegia.

1.2.1 HEMIPLEGIA

Hemiplegia is derived from the Greek words hemi (half) and plegia (paralysis), and means total paralysis of one side of the body, including the face, arm and leg. The term hemiparesis, used interchangeably with Hemiplegia, is defined as weakness on one side of the body. Hemiplegia is a condition affecting one side of the body. Hemi means half. A right or left hemiplegia may occur. It depends upon the affected side of the body. It is caused by damage to some part of the brain.

_Congenital or infantile hemiplegia_ refers to brain injuries[11] that occur before or at birth and lead to hemiplegia. Hemiplegia is the physical manifestation of an injury to a specific area of the brain that controls motor function. Hemiplegia may develop suddenly, or evolve over days, weeks or months. In addition, some infants who appear normal in the newborn period may show symptoms of hemiplegia only after voluntary hand use develops, at about 4-5 months of age. Hemiplegia can also be short-lived or permanent.
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Hemiplegia is a form of cerebral palsy that affects one arm and leg on the same side of the body. Double hemiplegia can occur but usually it affects the right and left sides in different ways and is different from spastic quadriplegia both on scans of the injury and its affect on the movement and posture of the legs. In most cases the arm is more affected than the legs, and the problem is often worse in the foot and head then they are at the hip and shoulder. Problems can sometimes arrive related to the spasticity and growth of the affected muscles.

It has been seen that loss of strength in the arm, leg and sometimes face on one side of the body is the frequent distribution of paralysis in the human beings. This type of the diseases localized in the paralytic attack is due to involvement of the descending motor tracts.

The site or level of the lesion can be determined from the associated neurological findings. It is well established that the diseases localized in the cerebral cortex, cerebral white matter and internal capsule generally evoke weakness or paralysis of the face, arm and leg on the opposite side. A pure hemiplegia affecting simultaneously the face, arm and leg indicates a lesion in the posterior limb of the internal capsule.

Studies show that damage to the corticospinal and corticobulbar tracts in the upper portion of the brain stem are the causative factors of the paralysis of the face, arm and leg on the opposite side. The lesion is localized by the presence of a paralysis of the muscle supplied by the oculomotor nerve on the same sides as the lesion in such type of the cases.

It has already been reported that muscle atrophy of minor degree is associated with hemiplegia. It never reaches the proportion seen in diseases of the lower motor neurons. When the motor cortex is adjacent parts of the parietal lobe are damaged in the childhood, the normal development of the muscle and the skeletal system in the affected limb is retarded, the palsied limbs and even the trunk on one side are small in nature.
This does not occur if the paralysis begins after the greater part of the skeletal growth is attained generally after puberty. If there is associated damage to horn cells or ventral roots, in the hemiplegia due to spinal cord Injury, muscles at the level of the lesion may undergo atrophy. It has been well established that vascular diseases of the cerebrum and brain stem exceed all others as causes of hemiplegia. Trauma (brain contusion), epidural and subdural hemorrhage, are placed at the second rank, and other diseases such as brain tumor, brain abscess and encephalitis, demyelinating diseases, and complications of meningitis, tuberculosis, and syphilis are less important.

There are several areas within the brain where an injury can lead to hemiplegia. Each area of the brain has special functions and areas of the brain also work together. The left cerebral hemisphere controls the right side of the body and the right cerebral hemisphere controls the left side of the body. Thus an injury to the right side of the brain can lead to weakness on the left side of the body or left-sided hemiplegia.
Hemiplegia in children\cite{12} is due to a number of different causes and includes blood vessel disorders (stroke), infection, trauma, tumors and other rare causes. The most common cause of hemiplegia is due to a stroke or vascular disorder. Stroke is due to a problem with one of the blood vessels in the brain. The circulatory system is like a pumping system with a pump (heart), pipes (blood vessels) and fluid (blood). Blood vessels carry blood and oxygen to the brain. A stroke occurs when there is an insufficient amount of blood and oxygen to the brain. This can be due to a breakdown in the pump (heart disorders), a blockage or break in one of the pipes and or a problem with the blood. A blockage in the blood vessel leads to a decreased amount of blood and oxygen to that area of the brain and causes the tissue to die.

The piping system in the brain consists of many different blood vessels or arteries. The blood vessel that is most commonly blocked or affected is the *middle cerebral artery*. The middle cerebral artery is the largest of the branches of the internal carotid artery, the large artery in the neck. The middle cerebral artery transports blood and oxygen to areas in the brain that among other things controls motor function. Thus a blockage in the middle cerebral artery typically leads to hemiplegia. Infections can also cause hemiplegia. Infections can penetrate into the brain and injure the tissue that controls motor function. Trauma to the head can cause damage to the underlying brain tissue and may lead to the development of hemiplegia. Tumors increase in size over time and may compress the area of the brain that controls motor function and produce hemiplegia. Further research is needed in childhood stroke and other disorders that cause hemiplegia in children. Studies are needed to identify risk factors and determine the best treatment and prevention of Hemiplegia in children.

Hemiplegia is total paralysis of the arm, leg, and trunk on the same side of the body. Hemiplegia is more severe than hemiparesis, wherein one half of the body has less marked weakness. Hemiplegia may be congenital or acquired from an illness or stroke.
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The term Hemiplegia means that the paralysis is on one vertical half of the body. A similar medical term, Hemiparesis, means a weakness on one side of the body. In children with hemiplegia, the paralysis in the body occurs on the side opposite the affected part of the brain. For example, if the left side of the child's brain is injured, then the paralysis will be on the right side of the child's body.

Hemiplegia is not an uncommon medical disorder. Strokes are the most common cause of hemiplegia. The most common cause of hemiplegia is a cerebrovascular accident, also known as a stroke. Strokes can cause a variety of movement disorders, depending on the location and severity of the lesion. Hemiplegia is common when the stroke affects the corticospinal tract. Other causes of hemiplegia include spinal cord injury, specifically Brown-Séquard syndrome, traumatic brain injury, or disease affecting the brain. As a lesion that results in hemiplegia occurs in the brain or spinal cord, hemiplegic muscles display features of the Upper Motor Neuron Syndrome[13]. Features other than weakness include decreased movement control, clonus (a series of involuntary rapid muscle contractions), spasticity, exaggerated deep tendon reflexes and decreased endurance.

In children, the majority of cases of hemiplegia has no identifiable cause and occurs with a frequency of about one in every thousand births. It is well known that the incidence of hemiplegia is a lot higher in premature babies than term babies. There is also a high incidence of hemiplegia during pregnancy and experts believe that this may be related to either a traumatic delivery, or use of some event which causes brain injury.

Hemiplegia in adults includes trauma, bleeding, brain infections and cancers. Individuals who have uncontrolled diabetes, hypertension or those who smoke have a higher chance of developing a stroke. Weakness on one side of the face may occur and may be due to a viral infection, stroke or a cancer.

The exact cause of hemiplegia is not known in all cases, but it appears that the brain is deprived of oxygen and these results in the death of neurons. When the
corticospinal tract is damaged, the injury is usually manifested on the opposite side of the body. For example if one has an injury to the right side of the brain, the hemiplegia will be on the left side of the body.

The symptoms of Hemiplegia depend on where the injury to the spine has occurred. Further, the symptoms also depend on the intensity of injury. Symptoms of hemiplegia depend on which side of the spinal cord or brain has been damaged. In general symptoms usually occur on the side opposite the injury. The symptoms of Hemiplegia include:

- Complete paralysis of one whole side of the body involving the face, arms and legs,
- Difficulty with speech and understanding speech,
- Trouble eating and swallowing food,
- Difficulty maintaining an upright posture when sitting,
- Trouble maintaining balance with eyes closed,
- Having trouble maintaining bladder control,
- Having diminished sensation of pain, temperature or touch,
- Confusion, loss of memory or lack of concentration,
- Mood alterations including frustration, anger and anxiety,
- Depression.

Not all the above symptoms occur at the same time in all patients with hemiplegia. Once hemiplegia is long standing, other complications include development of blood clots in the leg, atrophy of muscle from disuse.

The treatment of hemiplegia is geared towards trying to develop maximum function of the paralyzed body[14]. To prevent complications, the individual is placed on blood thinners to ensure that blood clots do not form. The primary therapies for individuals who have paralysis include entering a program of physical and occupational therapy. Those individuals who can’t speak may need to undergo speech therapy and
learn how to speak, write and understand speech. Physical therapy is vital and may include daily living activities to keep the muscles stimulated and prevent joint contractures. Some individuals may benefit from anti spasmodic drugs to relieve muscle spasms. Sometimes the surgeon may have to relieve joint contractures to relieve the deformity from prolonged spasticity.

Other treatments include wearing braces and splints. Individuals who have seizures may require anti seizure medications. Today a number of surgeons inject Botox to help relieve painful muscle spasms in children. Botox does work but its actions are short lived and repeat injections are necessary. When the back is completely broken after a motor vehicle accident, the surgeon may use a rod to stabilize the back. This surgery is not difficult but is only done to support the back and does not cure the paralysis. Some individuals may have difficulty breathing or eating and may require an artificial tube in the neck to breathe (tracheotomy) or a tube in the stomach for feeding (G-tube).

Finally, there are some individuals who have complete paralysis and will not benefit from any of these therapies. These individuals may need a special bed to help prevent pressure sores and assist in upper body using arm bars. There are hundreds of alternative care treatments for hemiplegia which include use of herbs, acupuncture, massage, yoga, meditation and health supplements. The majority of these alternative treatments just offer false promises and border on scams. If you do decide to use any such treatment, discuss this with your physician first. There have been instances where more harm has been caused from these treatments, plus they are also expensive.

Treatment should be based on assessment by the relevant health professionals, including physiotherapists, doctors and occupational therapists. Muscles with severe motor impairment including weakness need these therapists to assist them with specific exercise, and are likely to require help to do this.

Drugs can be used to treat issues related to the Upper Motor Neuron Syndrome. Drugs like Librium or Valium could be used as a relaxant. Drugs are also given to
individuals whom have recurrent seizures, which may be a separate but related problem after brain injury. Surgery may be used if the individual develops a secondary issue of contracture, from a severe imbalance of muscle activity. In such cases the surgeon may cut the ligaments and relieve joint contractures. Individuals who are unable to swallow may have a tube inserted into the stomach. This allows food to be given directly into the stomach. The food is in liquid form and instilled at low rates. Some individuals with hemiplegia will benefit from some type of prosthetic device.

Rehabilitation is the main treatment of individuals with hemiplegia. In all cases, the major aim of rehabilitation is to regain maximum function and quality of life. Both physical and occupational therapy can significantly improve the quality of life. Physical therapy can help improve muscle strength, mobility such as standing and walking, and other physical function. Occupational therapy may help the individual train daily living activities like brushing teeth, combing hair or dressing. Initially, one may undergo physical therapy at a center but many of these exercises can also be done at home and become part of daily life routine.

Hemiplegia is not a progressive disorder, except in progressive conditions like a growing brain tumor. Once the injury has occurred, the symptoms should not worsen. However, because of lack of mobility, other complications can occur. Complications may include muscle and joint stiffness, loss of aerobic fitness, muscle spasms, pressure ulcers and blood clots.

Sudden recovery from hemiplegia is very rare. Many of the individuals will have limited recovery, but the majority will improve from intensive, specialized rehabilitation. Potential to progress may differ in cerebral palsy, compared to adult acquired brain injury. It is vital to integrate the hemiplegic child into society and encourage them in their daily living activities. With time, some individuals may make remarkable progress.
1.2.2 PARAPLEGIA

Paraplegia is impairment in motor or sensory function of the lower extremities. The word comes from Ionic Greek: "half-striking". It is usually the result of spinal cord injury. The area of the spinal canal which is affected in paraplegia is either the thoracic, lumbar, or sacral regions. If both arms are also affected by paralysis, quadriplegia is the proper terminology.

While some people with paraplegia can walk to a degree, many are dependent on wheelchairs or other supportive measures. Impotence and various degrees of urinary and fecal incontinence are very common in those affected. Many use catheters or a bowel management program (often involving suppositories, enemas, or digital stimulation of the bowels) to address these problems. With successful bladder and bowel management, paraplegics can prevent virtually all accidental urinary or bowel discharges. Due to the decrease or loss of feeling or function in the lower extremities, paraplegia can contribute to a number of medical complications to include pressure sores, thrombosis and pneumonia. Physiotherapy and various assistive technologies, such as a standing frame, as well as vigilant self observation and care may aid in helping to prevent future and mitigate existing complications.

Causes of Paraplegia

Following is the some causes, that could possible cause paraplegia include:

- Spinal code injury
  - Accidents
  - Spinal fracture
  - Acute blood loss
  - Trauma
  - Katayama fever
  - Motor neuron disease
  - Stroke.

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As paraplegia is most often the result of a traumatic injury to the spinal cord tissue and the resulting inflammation, other nerve related complications can and do occur. Cases of chronic nerve pain in the areas surrounding the point of injury are not uncommon. There is speculation that the "phantom pains" experienced by individuals suffering from paralysis could be a direct result of these collateral nerve injuries misinterpreted by the brain.

It has been seen that parasagittal tumors and hydrocephalus may cause leg weakness occasionally. If the onset is acute, it may not be very easy to distinguish spinal paralysis from neural paralysis. It is also well established that in acute spinal cord diseases the paralysis affects all muscles below a given level. If the white matter is damaged, sensory loss below a particular level is conjoined. In bilateral diseases of the spinal cord, the bladder and bowel sphincters are paralyzed. Alternations in cerebrospinal fluid such as dynamic block increase in protein or cells are frequent.

In peripheral nerve diseases both sensory loss and motor loss tend to involve the distal muscles of the leg more than the proximal ones, and the sphincter's are spread or briefly deranged in function. If any sensory loss, present, is more likely to consist of distal impairment of touch, vibration, and position sense, with pain and temperature sense spread in many instances. It has been established that the cerebrospinal fluid (CSF) protein level may be normal and elevated.

Paraplegia is a paralytic condition that affects the lower body. Someone who has mid-body paralysis affecting the arms but not the legs has just that: paralysis. Paraplegia is simply a specific type of paralytic condition that affects the lower body; quadriplegia is also another paralytic condition, affecting the lower body, as with paraplegia, as well as at least part of the upper body.

**Signs and symptoms**

Symptoms will depend on how much of the spinal cord is involved. Symptoms include:
Loss of movement or muscle control in the legs, feet, toes or trunk,

- Loss of sensation in the legs, feet, toes or trunk,
- Tingling in the legs, toes or trunk,
- Loss of bowel and bladder control,
- Sexual dys function.

**Figure 1.2: Spinal cord injury**

Some research have been done by various scientists, details are given below:

- Peter, J. B. et al.[15] have studied the case of hemiplegic migraine during pregnancy. They observed from the magnetic resonance imaging a superficial cerebral hemisphere signal abnormality with enhancement. Single photon emission computed tomography scanning confirmed hyper fusion of the hemisphere. Hemiplegia was caused and sustained by hyper fusion.

- Siragusa, M. et al.[16] have studied nail pathology in patients with hemiplegia. They found the three different fingernail conditions, which were associated with hemiplegia. They are longitudinal reddish striation, neapolitan nail and unilateral clubbing.
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Tarkowski et al.[17] have given their contributions on localization of the brain lesion affects the lateralization of T-Lymphocyte dependent cutaneous inflammation. They found that a frontal cortex putamen region, which is responsible for the regulation of the magnitude of the immune responses.

Shirayama, H. et al.[11] have studied and found an evidence regarding the acute brain injury. It may be a cause of the neurological deficit.

Jancar, J. et al.[18] have studied the life expectancy of mentally retarded hemiplegics and they found people with hemiplegia have the prospect of reaching pensionable age and beyond.

Rozman, J. et al.[19] studied the selective stimulation of the common peroneal nerve for hemiplegia and found that the velocity of natural gait, cadence and stride length were significantly increased. The natural gait of the patient was still slower than in healthy individual.

Peter, H.B. et al.[12] have reviewed an article on the hemiplegic child and given a thought regarding hemiplegia. Hemiplegia due to stroke occurs in patient with cerebral vascular malformations, trauma, central nervous system (CNS) infection, coagulopathies, vasculitides and congenital and acquired heart disease, immunological system and metabolic disorders.


They did not find any single intervention, which offers a dramatic effect in terms of treating pain in the hemiplegic shoulder. There is potential for some benefits for the patients functional and comfort status, thereby improving their quality of life and maximizing their social participation.

Secondly, because of their depressed functioning and immobility, quadriplegics are often more vulnerable to pressure sores, osteoporosis and fractures, frozen joints, spasticity, respiratory complications and infections, autonomic dysreflexia[20], deep vein
thrombosis, and cardiovascular disease. Severity depends on both the level at which the spinal cord is injured and the extent of the injury.

At the 2007 world congress in reconstructive hand surgery and rehabilitation in tetraplegia a resolution was presented and accepted that indicates that every person with tetraplegia should be examined and informed concerning the options for reconstructive surgery of the tetraplegic arms and hands. With this resolution it becomes clear that it is necessary to increase the awareness on this subject[21]. These surgical procedures are further discussed in Tetraplegic Upper Limb Surgery.

Even with "complete" injuries, in some rare cases, through intensive rehabilitation, slight movement can be regained through "rewiring" neural connections, as in the case of the late actor Christopher Reeve [22].

The etiology of paralytic disorders at molecular level is still an open question.

Figure 1.3: Pictorial representation of Hemiplegia, Paraplegia, Quadraplegia
1.3 REFERENCES


Chapter 1: Introduction


