Spinal Cord Injury Due to Automobile Accidents

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Rod Keller

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Dear Mr. Keller:

I am submitting my research report titled “Spinal Cord Injuries Due to Automobile Accidents” that is due on Dec 5, 2013.

In my report I plan to examine the damages to specific regions and the effects. Imaging aspects such as which ones are preferred and how they affect the procedures and future prospects will be looked at. I have described on the specific discs affected by injury and the diagnosis that follow. I am even more interested in the critical hours in which doctors are determining the exact injury and severity. It is here where the choices of which imaging technology will provide the quality they need and in a timely manner. Medical Imaging plays a huge role in these situations and has given doctors a less invasive way to observe the injury; this key in determining where and how to do surgery.

I examined an article by The Journal of Craniovertebral Junction and Spine, where research was conducted to focus on the diagnosis and prognosis in spinal trauma, emphasizing on how MRI and CT are used. This report will provide the advantages of using MRI but also how CT can be used in combination to provide the best patient care. I believe the resources I have used are reputable, and I hope you find this report informative, accurate, and understandable.

Sincerely,

Kaylee Bearnson
Abstract
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Introduction

In the sudden moment of an automobile accident, many injuries can be inflicted on the human body. One of the most devastating is spinal cord injuries (SCI). Up to 40% of these reported cases were due to an automobile crash. In such cases an individual must look into the type of injury, the severity, and the location in order to gain relative knowledge about what a spinal injury consists of. This report presents an understanding of spinal cord injury.

Spinal Cord Injury needs to be taken seriously and with advancing MRI and imaging technologies we are able to further understand and investigate our bodies’ reaction to this emergency, develop better ways to improve recovery, and prevent as much secondary injury as possible. In cases where trauma has occurred to the spine and possibly the spinal cord, the means by which they observe the damage is crucial in deciding what to do next. This kind of accident can happen from car accidents, force applied by an object, sports, falling, and sometimes penetration. I plan to advocate the use of Magnetic Resonance Imaging, even after traditional radiographs or CT have been used. I will look at the extent of damage to the spine, spinal cord, ligaments, and tissues; one may be more useful for certain investigations. When looking at an injury the vertebrae, spinal cord, ligaments, and surrounding tissues, an MRI can: produce vivid images to correctly direct surgery, make assumptions about recovery, and is essentially the go-to modality to confirm or further investigate injuries. MRI is much more accurate in providing further evidence after fractures and displacement have been assessed. It seems that in any case where SCI is suspected, an MRI is necessary, even when others show nothing.
What is Spinal Cord Injury

Spinal cord injury (SCI) is defined as injury caused by trauma not disease, and it can result in pain and loss of function to certain areas of the body. The spinal cord attaches to the base of the brain and extends about 18 inches to the waist.

Complete vs. Incomplete:

One of most basic ways of classifying this injury is by whether it is complete or incomplete. Complete in this case is where no sensory or motor function can occur below the injury site, given that little function or sensory may be present or return after recovery. This usually means that the pathways, once used for messages, has been completely destroyed; this has some controversy because in determining if it is complete some function or senses may be present. While incomplete injuries only provide the fact that the spinal cord is only partially damaged, where this damage occurred also proves to be important.

Regional:

The different regions of the spine correlate with the effects of the injury. There is the cervical, thoracic, lumbar, and sacral region, while the coccyx is not included when evaluating injury (due to the fact that the spinal cord does not extend to this area of the spine). As the location of the injury moves down the spinal cord the parts of the body that are functional increases.

Looking at the five lower sacrum vertebrae, which are located at hip level, injury here will most likely result in little or no control of bowel or bladder, and possibly sexual dysfunction. There is also the possibility of weakness or paralysis of the hips and legs (paraplegia). The prospects for this injury if not complete is that he or she will most likely be able to walk. The lumbar region of the vertebrae and cord is also five vertebrae long and is next closest to the head.
after the sacrum. When this area is affected it is most likely that paraplegia will occur as well as possible loss of bladder and bowel function.

The thoracic region, where the ribs are located, is mostly responsible for loss of function and sensation in the legs and “trunk” as they refer to the abdomen and lower sexual organs. Most commonly they have to use braces to walk or cannot at all. This will include loss of bladder and bowel function, however usually the arms and hands are unaffected. As we look at the uppermost vertebral part of the spine, it is clear that all messages going to the body must pass here; this makes it the most severe of SCI’s. These eight sections must be divided into two groups. C1 through C4 are the very tip of the spine. Injury here will likely result in the following: paralysis in arms, hands, legs, and trunk (quadriplegia); may be unable to breath, cough, or control the bladder; possible speech impairment, assistance with daily activities, inability to operate a car, and a slight possibility of operating a wheelchair. Injury at the sites of C5 to C8 can cause a combination of: weakened breathing, assistance with a few or many daily tasks, some ability to move wrists and arms, but it varies from little movements to more complex ones such as operating a special vehicle, and paralysis of the trunk and legs.

**Types and Variation of Injury:**

All of the injuries above came from a specific type and direction of force. These include contusions, compressions, penetrations, and macerations of the vertebrae. Spinal contusions occur when the cord is bruised, causing inflammation and bleeding from the blood vessels. A compression is exactly how it sounds, when a pressure is exerted on the cord from a bone, vertebral fractures, or blood. Once any of these occur it becomes an emergency, as rapid deterioration can take place. Lastly maceration can occur which causes the skin and other tissue to soften due to excessive exposure to moisture as the blood fills the site of injury.
These will ultimately lead to secondary processes such as death of cells, neurons, oligodendrocytes, astrocytes, and precursor cells. The release of a pro-inflammatory, cytokines, causes further neuron and glial cell death, and tissue damage; it is unknown if or how the body uses this process to heal the wound in a SCI. Glutamate Excitotoxicity is used to describe the neuron death that occurs due to over activated receptor sites on the neurons when the glutamate is released after an injury. These will continue to have a degenerative effect on the spinal cord several hours and days after the injury. Spinal Cord Injury needs to be taken seriously and with advancing MRI and imaging technologies we are able to further understand and investigate our bodies’ reaction to this emergency, develop better ways to improve recovery, and prevent as much secondary injury as possible.
How Does MRI Produce Images

This scanner can basically pinpoint any part in the body and ask “what tissue is this” without the patient moving or adjusting. It will build a map of these points using a mathematical formula, Fourier Transform, to make an picture. Not only can this scan differentiate tissues, ligaments, and organs, it can give the radiologist different perspectives. These are also known as slices, and they can get create axial, sagittal, and coronal slices without the patient ever moving.

Parts of the Vertebrae:

Slices: compare MRI to CT (change title to be parallel)

The Machine:

The tube like part of the machine is known as the bore and it contains a superconducting magnet; hence the magnetic part of MRI. This is where coils reside and they allow electricity to flow, creating a large, stable magnetic field. A stronger field results in higher quality images. Liquid helium is in a vacuum around the coils, and is used to reduce resistance to almost zero. It can allow it to maintain a magnetic field up to 2.0 Tesla. Without this use of superconductivity, MRI would not be cost efficient at all to operate. Then other magnet and radio waves can be used in combination to depict images.

Our body is full of hydrogen atoms that have a strong magnetic movement, and when you go in the machine they all align in the direction of the field. When they align toward the head and feet, half and half, some are left unmatched. It is the ones left unmatched that are affected by the radio frequency that is turned on and off. The unmatched protons absorb this energy and spin, when its off they try to return to the original position. This is the resonance part of MRI. At the same time the gradient magnets are arranged so that they can can alter the main magnetic field in
a local area they are imaging. This allows for the slice view of the tissues and organs. Resistant, Gradient, and permanent magnets all work together here.
What Makes MRI the Best Choice

When trauma has occurred to the spine and possibly the spinal cord, the means by which they observe the damage is crucial in deciding what to do next. You must look at the extent of damage to the spine, spinal cord, ligaments, and tissues; which MRI can provide. When looking at the vertebrae, spinal cord, ligaments, and surrounding tissues of an injury, an MRI can: produce vivid images to correctly direct surgery, make assumptions about recovery, and is essentially the go-to modality to confirm or further investigate injuries. MRI is much more accurate in providing further evidence after fractures and displacement have been assessed. It seems that in any case where SCI is suspected, an MRI is necessary, even when others show nothing.

Clear Diagnosis:

In the presence of the image obtained by a CT or MRI the radiologist must make a diagnosis. In some cases this diagnosis may be critical and needed immediately, like when important ligaments that attach to the skull and spine have been damaged. The actions the surgeon and others must take to stabilize and act promptly depend on how quickly the images are obtained and what information they provide. While a CT scan may be faster than an MRI, it may not provide enough to clearly make a decision for surgery. The CT can show vertebral fractures and herniated or slipped disks, however an MRI can show spinal cord contusions, compressions, and macerations, as well as damage to the ligaments.

Surgery Insight:

Because SCI often involves surgery, the clear images provided by MRI allow them to plan accordingly. They can use it as a guide to inject steroids for pain, reducing inflammation, and
possibly reducing nerve cell damage. Also procedures such as decompression of a pinched nerve, spinal fusion, and removal of part or all of a disk between the vertebrae are greatly improved with the use of MRI. Follow up procedures also look at scarring and infection using this as well. Since Magnetic Resonance Imaging does not expose us to radiation therefore it is a safe method of imaging that can be repeated. This imaging technique is highly valuable, especially to spinal injuries. It aids efficiently in diagnosis specific damage and extent to the spinal cord in particular, which is important as this is what sends all the messages throughout the body. The prognosis of these injuries clearly correlates with the ASIA impairment scale results in the article “Diagnostic and prognostic role of MRI in spinal trauma, its comparison and correlation with clinical profile and neurological outcome, according to ASIA impairment scale” by Parashari, Khanduri, and Upadhyay. It also seems reasonable that it gives surgeons a better view of the damage, allows for the proper procedures to be planned, and keeps any surprises to a minimal.

**Prognosis:**

Decisions about the future prospects of the patient mostly come from the findings on imaging, but also combined with improvement as they heal. Instances where cord edema, contusion, hemorrhage, or ischemia have occurred, MRI can be a prognostic indicator. While sagittal (view) T1 weighted can show disk herniations, epidural fluid collection, subluxation, cord swelling, and cord compression. In comparison a T2 weighted image can better depict soft tissue abnormalities: cord edema and hemorrhage, and ligamentous injury too. In order to examine and determine neurological damage, doctors refer to the American Spinal Injury Association scale. It ranges from A to E, A being a complete spinal injury with no motor or sensory function is preserved in sacral segments, and E representing normal sensory and motor function.
A study done and published in the U.S National Library of Medicine, by Umesh C. Parashari, Sachin Khanduri, and Deepika Upadhyay, looked at the correlation between MRI findings in spinal trauma and neurological prognosis and outcome. Patients with larger cord edema (involving over 3 cm of the cord) had an initial high rating on the ASIA scale and less chance of recovery (p. 9). Cord hemorrhaging provided important prognostic factors, those who exceeded the sizable focus, 1 cm, tended to have larger cord edema and a more severe rating on the scale. They had a greater chance of retaining the complete injury at the follow up; patients with a small amount of hemorrhage showed better outcomes. The use of MRI significantly helps us evaluate these aspects of the spinal cord to help understand patient conditions and provide the best help. This means that MRI findings in acute spinal cord injury correlate well with initial and follow up findings (using the ASIA impairment scale).
Conclusion

Not only can this scan differentiate tissues, ligaments, and organs, it can give the radiologist different perspectives. There is the consideration of negatives, such as the need for the patient to remain still. If the images are distorted it can greatly affect the future care of the patient, so reimaging must be done. The high price of MRI’s is related to that, as well as initial cost of the machine and energy used to operate it. This means these could have been missed or overlooked without ordering an MRI. While a CT scan may be faster than an MRI, it may not provide enough information to make a diagnosis and plan for surgery. The CT can show vertebral fractures and herniated or slipped disks, however an MRI can show spinal cord contusions, compressions, and macerations, as well as damage to the ligaments.

The use of MRI significantly helps us evaluate these aspects of the spinal cord to help understand patient conditions and provide the best help. MRI findings in acute spinal cord injury correlate well with initial and follow up findings (using the ASIA impairment scale) making it the most reliable for this type of injury. Because SCI often involves surgery, the clear images provided by MRI allow them to plan accordingly. Follow up procedures also look at scarring and infection using this as well. Since Magnetic Resonance Imaging does not expose us to radiation therefore it is a safe method of imaging that can be repeated. This imaging technique is highly valuable, especially to spinal injuries. It aids efficiently in diagnosis specific damage and extent to the spinal cord in particular, which is important as this is what sends all the messages throughout the body.
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