CENTRAL CORD SYNDROME- A CLINICAL STUDY
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ABSTRACT

BACKGROUND
The importance of determining whether a patient has a complete or incomplete cord injury cannot be overemphasized in the overall prognosis. An incomplete spinal cord syndrome may be a Brown Sequard Syndrome, central cord syndrome, anterior cord syndrome, posterior cord syndrome or rarely monoparesis of the upper extremity. 90% of the incomplete lesions produce either a central cord syndrome, a Brown Sequard Syndrome or an anterior cord syndrome. Central cord syndrome is often missed in the casualty if the condition is suspected by the treating surgeon. We wanted to estimate the outcome of Central Cord Syndrome. We also wanted to estimate the age and gender distribution, mechanism of injury, and modalities of treatment regarding cervical spine injuries.2 and the importance of soft tissue shadow while evaluating X-Ray with cervical spinal injury.

METHODS
This is a hospital-based retrospective study conducted at Government Medical College, Kottayam, and Kollam, between 01/06/1993 to 31/12/1995 and 14/11/2018 to 30/4/2019. This study included 50 study participants. Most of the patients were from 30-50 years age group. Male to female ratio was 10:1.

RESULTS
Mortality rate was 2%. Flexion rotation injury was seen in 6 patients, and hyperextension injury was seen in 44 patients. During radiological examination, soft tissue shadow of 3-5 mms was seen in 12, more than 5 mms in 18, and no soft tissue widening in 2 patients. Causes of injury (mechanism-wise) included motor vehicle accidents- 32, falls- 14, sports- 0, acts of violence (e.g. diving)- 2 and others- 2.

CONCLUSIONS
The most common condition among the incomplete spinal cord injuries is CCS (Central Cord Syndrome). Distribution by aetiology- motor vehicle accidents comes first. People having cervical spondylosis and cervical canal stenosis were vulnerable to central cord syndrome. People in 30-50 years age group showed maximum prevalence. Hyper extension injury came first as the mechanism of injury. Flexion rotation can also produce central cord syndrome particularly in younger individuals.

KEYWORDS

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BACKGROUND
A case report from Govt. Medical College, Kollam made me to publish this article with the golden words of ‘KCG’. The eyes will not see anything if your mind is ignorant about that. A 32-year-old gentle man with RTA with multiple injuries was analysed in a tertiary care centre. CT head taken but no trauma related injury noted. Ultrasound abdomen showed no internal injury. He was referred back to Govt. Medical College, Kollam for IP care. On examination he has got weakness of bilateral had most pronounced in the rt. Hand. The planar reflex was extensor. Cervical spine x-ray showed soft tissue shadow normal and straitening and features of spondylosis even though he is young. Tell-tale evidence fore head injuries was there. Treated him conservatively.

Proper management of a person with a cervical spinal cord injury depends upon an accurate diagnosis of the type and severity of spinal cord damage. In 1970 Sir Frank Holdsworth stated that in his experience a person who sustains a sudden, complete loss of motor power and sensation secondary to trauma to the spinal cord which persists for 24 hrs will demonstrate no functional recovery. Incomplete spinal cord injury syndromes reviewed and described by Schneider et al. (1954) and Bosch et al. allowed the following generalizations to be made.1
1. The more sparing of muscle and sensory functions distal to the injury, the greater the expected recovery.
2. The more rapid the recovery, the greater the amount of recovery that can be expected and when new recovery ceases and the patient reaches a plateau, no further recovery of cord function can be expected. 90% of incomplete spinal injuries can be classified in one of the

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three clinical syndromes. The first and most common is central cord syndrome which consists of destruction of the central part of the cord involving grey matter and the most central pyramidal and spino-thalamic tracts. Second incomplete syndrome is the hemic section called Brown Sequard syndrome and the third is the Anterior Cord Syndrome. Posterior cord syndrome (caused by extension injury) and Mixed syndrome are usually rare.2

**Pathological Anatomy**

It usually results from a hyperextension injury in an older person with pre-existing osteoarthritius of the spine. The spinal cord pinched between the vertebral body anteriorly and buckling of ligamentum flavum posteriorly. It can also may occur in younger patients with flexion type of injury. The importance of determining whether a patient has a complete or incomplete cord injury cannot be over emphasized in the overall prognosis. A complete cord injury means total sensory and motor loss distal to the injury whereas incomplete injury means some sensory or motor or both is spared. Incomplete spinal cord injuries include the most common central cord syndrome and the less common brown Sequard syndrome, anterior cord or posterior cord syndromes and mono paresis of the upper extremity.3 The central cord syndrome is otherwise called Man in Barrel Syndrome4,5 Why? Weakness is more pronounced in the arm. How? This is a container content imbalance explained in Figure 1.

**Primary Objective**
To estimate the outcome of Central Cord Syndrome.

**Secondary Objectives**
1. To estimate the age and gender distribution, mechanism of injury, and modalities of treatment regarding cervical spine injuries.
2. The importance of soft tissue shadow while evaluating X-Ray with cervical spinal injury.

**METHODS**

**Type of Study**
Hospital-Based Retrospective Study.

**Setting**
Government Medical College, Kottayam and Kollam.

**Study Period**
01/06/1993 to 31/12/1995 and 14.11-2018 to 30.4.2019.

**Study Subjects**
Persons having cervical spine injuries admitted in Government Medical College, Kottayam coded properly during the period of 5 years backward from 01.06.1993 were taken. 150 cases were noted from the registry whom we had recalled by postal card. 50 cases came to outpatient department for assessment.

**Sample Size Assessed**
50

**RESULTS**

**Sample Size**
50.

**Age Distribution**
30-50 yrs.- 38
More than 50 yrs.- 12

**Gender Distribution**
Male-46
Female-4.

**Outcome of Study**
Mortality- 1 (Male)
Actinomycosis- 1
Pre-vertebral abscess- 1

One case with unilateral (Rt.) sided weakness whose X-ray showed spinous process avulsion fracture at C6 level; the soft tissue shadow in this case was 3 mms. Brown-Sequard syndrome- 2. Sprain of cervical spine- 8. Central cord syndrome- 36.

**Clinical Mechanism of Injury**
Flexion rotation injury-6 (All were less than 50 years category). Hyperextension injury-44; (Age Above 50-12 and 30-50 yrs.- 32)
Radiological Examination
The soft tissue shadow against C3 Vertebra is taken
Without soft tissue widening- 2
Soft tissue shadow 3-5 mms- 12
More than 5 mms- 18

Causes of Injury (Mechanism-Wise)
Motor vehicle accidents- 32; Falls- 14; Sports- 0; Acts of violence (e.g.: Diving)- 2; Others- 2. Tell-tale evidence of forehead abrasions and lacerations was present in 44 subjects. All cases above 50 years showed features of cervical spondylosis. Of the 38 cases between ages (30-50) 25 had features of cervical spondylosis.

Treatment Modalities Adopted
Total- 50; Operated- 2 (Subjects with Actinomycosis and Pre-Vertebral Abscess); Conservative- 47; Mortality- 1.

Table 1. Cervical Spine Injuries in Govt. Medical College, Kollam Seeking IP Care During 14.11.2018 to 30.4.2019

<table>
<thead>
<tr>
<th>No.</th>
<th>Nature of Injury</th>
<th>Age</th>
<th>Gender</th>
<th>Diagnosis</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RTA</td>
<td>45</td>
<td>Male</td>
<td>Quadriplegia with Sub Dural Hematoma.</td>
<td>Died at 15th day</td>
</tr>
<tr>
<td>2</td>
<td>RTA</td>
<td>32</td>
<td>Male</td>
<td>Central Cord Syndrome</td>
<td>Conservatively Treated</td>
</tr>
<tr>
<td>3</td>
<td>RTA</td>
<td>43</td>
<td>Male</td>
<td>Stable C6 compression fracture, No deficit</td>
<td>Conservatively Treated</td>
</tr>
<tr>
<td>4</td>
<td>RTA</td>
<td>45</td>
<td>Female</td>
<td>Spinal with straining of cervical spine, no deficit</td>
<td>Conservatively Treated</td>
</tr>
<tr>
<td>5</td>
<td>RTA</td>
<td>42</td>
<td>Male</td>
<td>Quadriplegia, Hemorrhagic contusion of cervical cord</td>
<td>Referred to Higher Centre</td>
</tr>
<tr>
<td>6</td>
<td>Fall</td>
<td>38</td>
<td>Male</td>
<td>CCS, Soft tissue shadow 5 mms at the level of C3</td>
<td>Conservatively Treated</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>THE BARTHEL INDEX (ADAPTED)</th>
<th>CAN DO BY SELF</th>
<th>CAN DO WITH HELP OF SOMEONE ELSE</th>
<th>CANNOT DO AT ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canting from a nap (1)</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Eating</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dressing unaided</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dressing with aided</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Puts on brace or artificial aid</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Getting in or out of bed</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wasting or eating</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Controlling bladder</td>
<td>11</td>
<td>5 (assistance)</td>
<td>0</td>
</tr>
<tr>
<td>Central and lower movements</td>
<td>11</td>
<td>0 (assistance)</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Maximum Self-care subscore possible is 63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum mobility subscore possible is 47</td>
</tr>
</tbody>
</table>

DISCUSSION
The study shows that the central cord syndromes affect male victims of 30-50 years age group the most productive age period of a person. Tell-tale evidence of fore head abrasions and lacerations were present in 44 subjects. This explains the importance of physical examination and the correlation of fore head injury and cervical spine injuries in assessing and managing cervical spine injuries. 25 out of 38 had cervical spondylosis which shows the association of cervical spine injuries with the cervical spondylosis. In our study the bladder dysfunction of all central cord syndrome victims recovered within 6 months period. Perkash. I. in his study regarding management of neurogenic bladder dysfunctions following acute traumatic cervical central cord syndrome (incomplete tetraplegia)says based on the experience to date with central cord syndrome most or all of the following conditions should be present before considering transurethral sphincterotomy. Shincterotomy is indicated in patients with persistent residual urine level over 300 mls, prolonged intermittent Catherization over 6 months period, 50 years or more persons with marked spasticity of bladder etc. In our study we have put all suspected cases with catheter and removed it as early as possible to replace it with intermittent catheterization.

Here Nobody developed bowel dysfunction on follow up. Most of the patients given soap and water enema maximum up to 5 times. Assessing the neurological recovery some amount of spasticity was present in lower limb in 50% of patients. The residual palsy was weakness of intrinsic muscles of the hand. 2 cases had mild flexion deformity of wrist & fingers which is made usable by physiotherapy in one case and the other treated by flexor tendon lengthening. Assessing the x-ray, we had found the salient features of central cord syndrome were soft tissue widening, evidence of cervical spondylosis etc. Young patients had fracture dislocation, spinous process fractures etc., as well. MC Goldrick J.M, Marx. A reported one case of abnormality of odontoid process i.e., Odontoideum 1989.
Functional Assessment
The goal of rehabilitation medicine is to restore patients to optimal functioning, four commonly used functional assessment scales are the following:7
1. For overall disability evaluation
   a) PULSES profile. b) Barthel Index
2. For assessment of brain injury.
   a) Glasgow outcome scale. b) Rancho Los Amigos Levels (Rancho) scale of Cognetive Recovery.

Here in this study I made use of Barthel Index (adapted) for the assessment.

Barthel Index
Developed in 1965 by Barthel & Ivlahoney consists of 10 activities of daily living (ADLs) variables in which the patient receives a score. A score of 60 or less indicates severe disability. However, a score of 100 shows only that a patient does not need an attendant, not necessarily that she/he is able to live completely alone.

Barthel index are not measuring the patient’s ability to cook or keep house like skills and also it could not address functional impairment related to general health status, communication skills and psychosocial problems. Discussing “acute traumatic central cord syndrome (ATCCS) and MRI pathological correlations” suggests central grey matter and the centrally related corticospinal tracts are get affected. But one report from Department of Radiology, University of Miami MRI center, Florida; states that the ATCCS is commonly stated to result from an injury which affects primarily the centre of the spinal cord and is frequently hemorrhagic. To test the validity of this widely disseminated hypothesis, the magnetic resonance images of 11 consecutive cases of ATCCS caused by closed injury to the spine were analysed and correlated with the gross pathological and histological features. Ten of the 11 patients had pre-existing spondylosis and or canal stenosis. All patients exhibited hyper intense signals within the parenchyma of the cervical spinal cord on gradient echo MRI. None showed MRI features characteristic of haemorrhage on T1 weighted or T2 weighted gradient echo studies. Gross and histological examination of the necropsy specimens showed no evidence of blood or blood products within the cord parenchyma the primary finding was diffuse disruption of axons especially with in the lateral column of the cervical cord in the region occupied by the corticospinal tracts. In patients with Acute Traumatic Central Cord Syndrome (ATCCS) the predominant loss of motor function in the distal muscles of the upper limbs may reflect the importance of the cortico-spinal tract for hand and finger function in the primate.8,9

We suggest that the most common mechanism of injury in ATCCS may be direct compression of the cervical spinal cord by buckling of the ligamentum flavum into an already narrow cervical spine space and thus occurs axonal injury of the lateral column white matter.

Principles of Treatment
Apart from the maintenance of vital sign and initial neurological assessment one should remember the 3 classical clinical features which can occur in spinal injury above T 6. They are Hypotension, Hypothermia, Bradycardia. It seems that Methyl prednisolone infusion within 8 hours of injury showed significantly more improvement in motor function and pin prick and touch sensation at 5 weeks and at 6 months after injury. The administration consisting of a bolus dose of 30 mgs/kg body administered over 15 mts. Followed by a 45 mts pause and then a 23hr continuous infusion at 5.4 mgs/kg/hr. Because of the massive dose of steroid administered over a 24 hrs period there is the potential for increased incidence of wound infection and gastrointestinal hemorrhage and also arrythmia.3,10

The goals of treatment of cervical spine injuries are; 1) To realign the spine 2) To prevent loss of function of undamaged neurological tissue. 3) To improve neurological recovery 4) To obtain and maintain spinal stability and 5. To obtain early functional recovery.7 After initial medical stabilization and documentation of neurological function, spinal alignment can be obtained by skeletal traction. Continuous monitoring during reduction is essential to prevent iatrogenic injury from over distraction of an unstable motion segment. A general guideline is 10 pounds for the head and 5 pounds for each additional level of injury. If spinal realignment cannot be obtained by traction, open reduction and stabilization usually through a posterior approach are indicated. If spinal realignment obtained with traction and is documented radiologically weight is reduced by half to maintain alignment and the course of treatment is determined. Pre-operative radiological evaluation CT/MRI is helpful to demonstrate the pathological anatomy. If a disc is herniated anterior discectomy with or without anterior inter body fusion should be performed before posterior cervical wiring and fusion to avoid neurological deterioration.3

Many cervical spine injuries can be treated without surgery. For a stable cervical spine injury with no compression of the neural elements a rigid cervical brace or halo for 12 weeks usually produces a stable, painless spine without residual deformity. Stable compression fractures of the spine and undisplaced fractures of the vertebral bodies the laminae, lateral masses or spinous processes also can be treated with immobilization in a cervical orthosis. Patients with spinal fractures that are treated non-operatively must be observed closely. Weekly X-Rays for the first 3 weeks then 6 weeks, 3 months, 6 months and one year. Even though adequate initial physical and x-ray examinations were done, sub-acute instability demonstrated by Herkowitz and Rothman, due to the elastic and plastic deformation of the ligamentous structures and discs of cervical spine can be possible so a second complete evaluation should be performed within weeks of injury.4
Surgical Treatment

Around 2000; Only one study report was there in the literature that is from Chang Gung Medical College, Kweishan, Taoyuan, Taiwan (1997 Nov.). Their conclusion was -surgical intervention for traumatic central cord syndrome must be addressed with careful clinical and radiographic survey. Unstable injuries of the cervical spine with or without neurological deficit require operative treatment. In most patients early open reduction and internal fixation are indicated to obtain stability. Cervical spine fractures may be stabilized through an anterior or posterior approach; usually a posterior approach is used with triple wire stabilization and fusion with iliac bone grafting. This allows rapid mobilization of the patient in a cervical orthosis and healing usually occurs within 8-12 weeks. If compression of spinal cord or root are by retro pulsed bone fragments or disc residues anterior decompression may be indicated to improve neurological recovery. Literature reported instability and recurrent deformity after anterior decompression and grafting in posteriorly unstable fractures. Posterior stability should be obtained first followed by anterior decompression and fusion if indicated except in the rare patient with a subluxation or dislocation that cannot be reduced by traction. MRI and or CT should be performed to determine if a disc is herniated. Some studies showed improved neurologic recovery in patients with both complete and complete cord injuries after anterior decompression and fusion. The complications both early and long term including metabolic complications influence the choice of the early surgical stabilization and mobilization of the patient. For posterior ligaments or bony instability posterior fusion with triple wire fixation and iliac bone grafting is indicated. The choice of surgical approach- Depends on the pattern of injury. Posterior approach are usually indicated for ligamentous instability. Anterior decompression and fusion are most often indicated for burst fractures of the cervical spine with documented compression of the neural elements and an incomplete neurologic deficit. Combined anterior decompression and posterior fusion are indicated for posterior instability and anterior compression of the neural elements. Further studies to be done to solve will the patient benefit by skeletal traction, early mobilization by halo and jacket, or surgical stabilization?

Other Treatment Considerations in Patients with Spinal Cord Injury

The victims of spinal injury have specific multi system complications related to their type of injury, co-morbid conditions, lack of mobility and mental depression. A person with no neurologic loss usually takes up to 12 weeks of bed rest to get the fracture healing well which he/she can tolerate. But prolonged bed rest can lead to social and psychological upset, muscle atrophy, joint stiffness and financial burden to the victim and his /her family as well. The first 2 weeks are the common time period of mortality. The morbidity is the great burden to the patient, this is not because of the fracture alone but can also because of the complications such as 1) Respiratory Complication. 2) Gastritis and Gastrointestinal bleeding. 3) Urinary distention and urinary tract infections. 4) Pressure sores. 5) Muscle weakness, contracture and joint stiffness. 6) Disuse atrophy of muscles and osteoporosis. 7) Psychological impact..

Gastrointestinal Complications

Usually tetraplegic patients we put nasogastric aspiration tube to protect him/her from the ileus and regurgitation and aspiration of gastric content along with H2 blockers and proton pump inhibitors usually pantoprazole. This will protect from the methyl prednisolone induced gastritis as well. Gastric bleeding from diffuse haemorrhagic gastritis is a common early complication. This occurs as early as the second day after injury and its cause is unknown. It may be due to the loss of the sympathetic nervous system activity and the unopposed parasympathetic activity of the vagus nerves.

Fluid Therapy Complications

The initial period of spinal injury is the period of sympathetic spinal shock when the blood pressure is low, and vasculature is dilated. If the patient is given excessive intravenous fluids during these periods, she/he may develop pulmonary oedema and congestive right heart failure. When the sympathetic tone returns and the excess fluid is forced out of the cardiovascular system mere diuresis by kidney may not be sufficient to remove the excess fluid load that had occurred, and pulmonary oedema may occur.

Bladder Care

During the first 24 to 48 hours the patient has hypotension owing to paralysis of the sympathetic reflex and the dilatation of the vascular tree; the urinary output is usually low. Therefore, intravenous and oral fluids should be restricted to cover the obligatory output and urinary flow only during these hrs. After the period of shock recedes, diuresis occurs at 36 to 48 hours. Urinary Catherization by Foley’s catheter is a usual procedure after the initial evaluation of the spinal injury victim. It should be put at utmost sterile precaution. In males, the catheter should be taped up on the abdomen to prevent a peno-scrotal fistula. After 48 hrs the intake and output are stabilized, the paralyzed bladder can be managed by sterile intermittent catheterization. Urinary tract Infection continues to be a recurrent problem inthe long-term management of paralyzed patients.

Skin Care

Patient is advised 2 hr change of position like a log of wood is turning owing to the anaesthesia of the skin. The bony prominences should be protected. Now a day’s special Mechanical rotating beds, water or air beds also available for skin care. Beds that support the patient on an air-flow system are more difficult to maintain in traction. During the first several weeks silent thrombophlebitis along with
pulmonary embolism compounds the pulmonary complications of patients. Unilateral lower extremity swelling may be the only sign of thrombophlebitis in the anaesthetic extremity. Physiotherapy to be established as early as possible to prevent deep vein thrombosis, thrombophlebitis and skin ulcerations.  

Respiratory Care
As secretions accumulate in the lungs of an acute quadriplegic patient; atelectasis develops, which leads to unresolved pneumonia that may lead to early death. Chest physiotherapy to be commenced as early as possible since the patient cannot forcibly cough or exhale. The use of intermittent positive pressure ventilator assistance with proper humidification several times in a day is essential to maintain full expansion of the lungs. The acute quadriplegic patients depend on diaphragm for respiration since the intercostals and abdominal muscles are paralysed. Tracheotomy is used if secretions cannot be cleared by oral suctioning. Often, fibro optic bronchoscopy is necessary to remove retained bronchial plugs and allow adequate ventilation. 

Limitations in the Study
It is only a hypothesis generating study, no comparison group. So, there is a good scope for a long-term prospective study of cervical spine injuries.

CONCLUSIONS
• Age Distribution: Group between 30-50 were most commonly affected.
• The most common condition among the incomplete spinal cord injuries is CCS (Central Cord Syndrome).
• Distribution by aetiology- motor vehicle accidents comes first.
• People having cervical spondylisis and cervical canal stenosis were vulnerable to central cord syndrome.
• Hyperextension injury came first as the mechanism of injury. Flexion rotation can also produce central cord syndrome particularly in younger individuals.
• Irrespective of with or without bony injury, the outcome of central cord syndrome was comparable. Even though all patients are independent according to the Barthe Index, all had intrinsic muscle weakness of both hands i.e. the interossei and lumbricals have power grade 3 or 4, and no-body had bowel or bladder dysfunction.
• Patients who were given dexamethasone or methyl prednisolone showed no difference in clinical outcome.
• No subjects having central cord syndrome had undergone surgical treatment in this study.
• While evaluating the x-ray, even though the soft tissue shadow is less than 3 mms, clinical assessment is important.

Acknowledgement
This original article is being published for tribute to a legend in orthopaedic surgery and a beloved teacher Professor of Orthopaedics, Late Prof. K.C. Gopalakrishnan popularly known as KCG on his first death anniversary (August-22). He was my mentor in this topic and this is my first research project. Even now the topic is relevant and many post graduates who have passed with very high scores are unaware of the condition and the importance of its management.

REFERENCES