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A Case Report of Prolonged Bradycardia in Clay Shoveler's Fracture: Presentation and Narrative Review

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Abstract

A spinal cord injury is an uncommon discovery in a clay-shoveler's fracture. Multiple syncope could be caused by bradycardia which followed a spinal cord injury. These combination findings adds its rarity. This case report aim to share awareness among physicians of the rare complication of spinal cord injury and its management. This descriptive report also narratively review other literature. Physicians should aware of SCIWORA (Spinal Cord Injury Without Radiographic Abnormalities), neurogenic shock and prolonged bradycardia as one of its complications and it may warrant a cardiac pace maker to avoid cardiac arrest and other complication.

Keyword: Spinal cord injury, Prolonged bradycardia, Clay-shoveler's fracture, SCIWORA

Case Report

Laporan kasus Prolonged Bradycardia Pada Clay Shoveler's Fracture: Presentasi dan Review Literatur

Abstrak

Cedera medulla spinalis adalah temuan yang sangat jarang pada kasus Clay-Shoveler's fracture. Pingsan berulang bisa disebabkan oleh bradikardia akibat cedera medulla spinalis. Kombinasi temuan jarang tersebut menambah keunikannya. Laporan kasus ini bertujuan untuk berbagi kewaspadaan bagi para dokter terhadap komplikasi langka akibat cedera medulla spinalis dan penanganannya. Laporan deskriptif ini juga secara naratif mengulas literatur lain. Dokter harus mengenal SCIWORA (Spinal Cord Injury Without Radiographic Abnormalities), syok neurogenik dan bradikardia yang memanjang sebagai salah satu komplikasinya dan mungkin memerlukan alat pacu jantung guna menghindari serangan jantung dan komplikasi lainnya.

Kata Kunci: *Cedera medula spinalis, Bradikardi yang memanjang, Clay-shoveler's fracture, SCIWORA*

INTRODUCTION

Neurogenic shock after a spinal cord injury is not an uncommon findings but a spinal cord injury is an uncommon discovery in a simple processus spinosus tip fracture case. Spinal cord injury generally does not occured if the fracture limited behind spinolaminar line (Feldman & Astri, 2001; Pinto et al., 2022)). The clay shoveler's fracture is an oblique spinous process fracture which occurs anywhere between C6-T3, with C7 and T1 are the most generally affected sites. This fracture is a stable type and usually managed by non-operative treatment. Prominent symptom is pain mostly resolve within weeks. (Posthuma de Boer et al., 2016) But when hypotension, bradycardia and loss of motor fuction below level of injury discovered, one should suspect a serious spinal cord injury. Spinal MRI were expected to show abnormalities such as edema, contusion, hematome or even transection. Yet normal result does not rule out the spinal cord injury as in SCIWORA (*Spinal Cord Injury Without*

Radiographic Abnormalities) type 1. Prolonged bradycardia is a rare complication of neurogenic shock. Its pathophysiology is still far from obvious (Boese & Lechler, 2013; Ghaffari-Rafi et al., 2021), moreover the consensus of its management (Shaikh et al., 2016; Wecht et al., 2020)

This rare case report will present a spinal cord injury with prolonged bradycardia in a simple case of clay shoveler's fracture which the fracture line lies far from spinolaminar line, had a normal MRI and managed by implantation of cardiac pacemaker. The aim is to share awareness to other physician regarding of vertebral trauma complications and management should they face them in the field.

CASE REPORT

A young man 21 years old , an electrician at a factory in West Java, came with complaints of weakness after falling from 3m heights when trying to repair cable at his workplace. Having an athletic body shape, and doing soccer sport once a week, he is a non smoker and has one son, and no history of dyspnea whatsoever before nor family history of heart diseases. Right after his fall, he could not move his arms and legs (reported motor scale 0 on all extremities). On arrival to nearby hospital, he was fully alert but suffer low blood pressure and bradycardia. After a complete radiology assessment, he was diagnosed Clay shoveler's fracture on C7 and T1 level (*figure 1*) with incomplete spinal cord injury ASIA B. There was no other abnormalities found. He was admitted to ICU where he fainted twice while lying on the bed. He was given atropine injection repeatedly to maintain the heart rate above 60. He also recieved high dose of methylprednisolon for 2 days. Since the accident happened at his workplace, the company willing to cover every cost if the complaints were related to the accident only. Presenting as a trauma case, bradycardia was becoming a question: was it related to the trauma or was it a precondition illness? Hence after a week of examination and intensive care, he was referred to our hospital. On arrival at day 7th, his blood pressure was normal, with heart rate around 20-45 beats per minute. He was complaining about having lightheadedness. We found slight weakness on his both legs (motor score 4) with full strength on both arms (motor score 5). To rule out differential diagnosis such as organic cardiac diseases, we performed tests such as electrocardiogram, echocardiogram, chest xray, and blood test which included troponin I, troponin T, CK-MB. We found prolonged QT with sinus bradycardia and slight cardiomegaly. Other tests result came out to be normal. Considering his previous health histories, activities, and supporting data from radiology and blood work up, we certain that this patient's cardiac abnormalities was a result from his spinal cord injury. He was given atropine 0,5 mg every hour to maintain his heart rate and decided to put a Transvenous Pace Maker (TPM) and set the heart 60 times per minute. We expected heart rate would improve in few days later while also explaining and assuring the circumstances to his employers. The patient was already on complete bed rest for 10 days straight. To prevent pnemonia and skin complication, on day 11th of bed rest (or 2 days after TPM) we decided to replace TPM with permanent pace maker (PPM). A double barrel pacemaker (Endurity MR DDDR, Saint Jude™) was inserted at left deltopecoral by cardiologist team. After the procedure, patient had a stable condition, no neck pain, no syncope, no short breath and started his physical rehabilitation for 4 days in our hospital. He was then discharged and decided to return to West Java. At 4 months follow up through phone, the patient had returned to his normal daily activities.

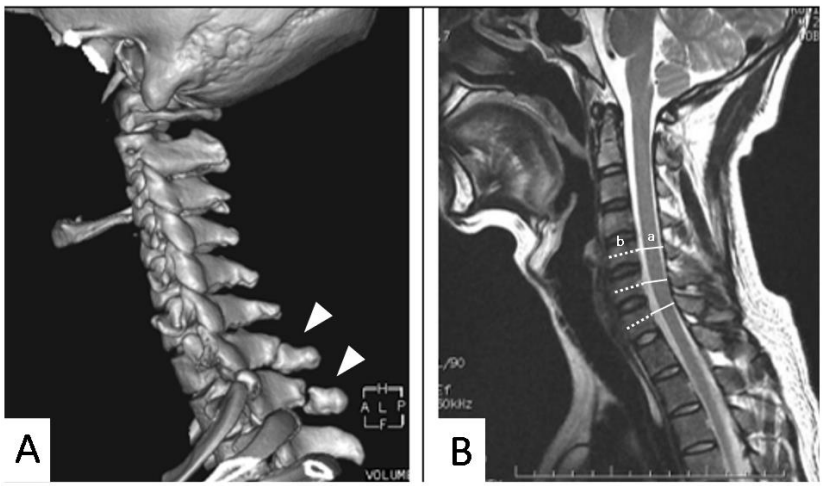

Figure 1. (A) Cervical CT scan revealed fracture on processus spinous C7 and T1 (arrow head) and (B) Cervical MRI showed Torq-Pavlov ratio 0.93 on subaxial level (a/b)

DISCUSSION

This case highlighted the significance of knowledge sharing among physician which in turn would benefit their patients, especially for rare cases. A spinal cord injury is a rare case with imminent challenging complication if not manage properly. Clay shoveler's fracture is another rare case which one would underestimate. To complete its rarity, this case confound with a prolonged bradicardya while other neurological symptoms vanished. The limitation of this study lied on its own nature but this report also might provide a valuable insight for experts in their future studies.

Clay Shoveler's Fracture

Three mechanisms involved in the causative mechanism of clay shoveler's fracture are direct, indirect and stress-related(Hetsroni et al., 2005; Khanpara et al., 2020; Pinto et al., 2022)). The direct mechanism is characterized by a strong blow directly to the spinous process leading to a fracture. The indirect mechanism is a true avulsion fracture. It is the most common mechanism of injury which the cervical spine undergoes a ballistic-type motion in flexion, hyperextension or rotation. During rapid hyperextension, the spinous processes are impacted and may fracture. In addition to flexion and extension, rotation of the neck or trunk can play a large role in spinous process avulsions, especially in the cervicothoracic region. The third mechanism may be regarded as a stress-related, fatigue-type fracture in which, repetitive normal stress may lead to a fatigue fracture especially to abnormal bone such as in hyperthyroid patients. The fracture point occurs approximately 1 to 2 cm from the tip of the spinous process, which is the weakest point ((Hetsroni et al., 2005; Pinto et al., 2022). We hypothesised that the second mechanism, hyperextension/ hyperflexion, occured to this patient.

Symptoms of this type of fracture were mostly neck pain, which usually resolved within 2 weeks. If the fracture extends to spinolaminar line, one should check of any cord injury. Conservative treatment is the first choice of treatment. Rest and restriction of activities generally result in good outcome. Surgery were recommended to overcome the persistent neck pain (Hetsroni et al., 2005; Kiriği, 2015; Olivier et al., 2016; Pinto et al., 2022)

Transient Weakness

Several mechanisms have been proposed to cause spinal cord injury including 1) hyperflexion causing spinal traction, 2) hyperextension causing extrinsic cord damage, and 3) edema or vascular injury causing parenchymal cord damage (Bonfanti et al., 2019; Ghaffari-Rafi et al., 2021; Mohanty et al., 2013) The severity of spinal cord injury (SCI) can range from transient to permanent injury. The least severe injury is known as neuropraxia, which is as a transient loss of motor or sensory function that last from 15 minutes to 48 hours (Jin et al., 2021). There are 6 classification of spinal cord injury based on MRI findings, they are: nomal, type 1 pattern (hemorrhage), type 2 pattern (edema), type 3 pattern (contussion), compression and transection (Martineau et al., 2019). Our patient was the normal type. Many experts suggested delayed or repeated MRI examination since it may provide useful information of current cord condition (Boese &

Lechler, 2013). We did not perform repeated MRI because of financial reason.

The pathophysiology of transient weakness involves a pincher-like compression of the cervical spine within the spinal canal. Patients with a Torg-Pavlov ratio less than 0.8 are at risk for transient weakness (ratio of spinal canal diameter to vertebral body diameter) (Jabola et al., 2021). Around 80% of these patients will have neural deficits in all extremites (Jin et al., 2021). About 74% of these will have a resolution of symptoms within 15 minutes. Another 11% will suffer more than 24 hours (Ludwisiak et al., 2019; Posthuma de Boer et al., 2016) Our patient's Torg-Pavlov ratio was 0.93. His neural deficits was improved in 7 days. Clinical and imaging factors were not significantly related to the type of SCI (complete or incomplete type) and the final outcome (Martineau et al., 2019).

Imaging

Magnetic resonance imaging (MRI) has become first choice to assess spinal cord injury. It is important in making diagnosis, providing therapy and predicting prognosis. Some experts described MRI patterns in spinal cord injury namely hemorrhage, edema, contusion, transection and compression pattern. Normal and swelling were considered as edema pattern (Martineau et al., 2019). The term SCIWORA (Spinal Cord Injury Without Radiographic Abnormality) indicates a clinically post-traumatic myelopathy without abnormalities on radiographs and/or computed tomography (CT), but approximately two-thirds of cases have abnormalities at MRI test (Boese & Lechler, 2013; Bonfanti et al., 2019)Boese & Lechler, 2013. The severity of cord damage match the neurological deficit; more severe neurological damage mostly found in more sever cord damage. The pathophysiology of SCIWORA including hyperfexion causing spinal cord traction injury, hyperextension causing extrinsic cord damage, and edema or vascular injury causing parenchymal cord damage (Konovalov et al., 2020). Based on MRI, SCIWORA were defined as type 1 if no abnormalities in MRI and as Type 2 for others. Type 2 were consisted of: extraneural, intraneural, and both (intra- and extraneural) abnormalities (Konovalov et al., 2020; Boese & Lechler, 2013). Most SCIWORA case improve afer the injury, hence no surgical treatment is needed although this is still debatable. Cases with complete spinal cord injury rarely improve. Those with incomplete type ofen improve but seldom regain normal function (Konovalov et al., 2020)((Ghaffari-Rafi et al., 2021)Bonfanti et al., 2019)(Martineau et al., 2019).

Cardiac Abnormalities

Spinal cord injury is too commonly associated with low blood pressure and bradycardia, which is caused by increased vascular resistance owing to loss of sympathetic innervation to heart. Sympathetic innervation of the heart arises from intermediolateral grey columns of T1 to T4 spinal cord segments which is under control of higher centers via cervical spinal cord. Parasympathetic innervation runs via vagus nerve (Hawayek et al., 2021; Mayà-Casalprim et al., 2020; Posthuma de Boer et al., 2016; Wecht et al., 2020; Yee et al., 2022). Following any spinal cord injury above T1, the control of sympathetic system is disrupted. One will find diminished sympathetic activity (recognized as 'decentralization' of sympathetic system) while the parasympathetic system remains undamaged (via vagus nerve), which results in relative parasympathetic surge and causing bradycardia, and even cardiac arrest. The higher the level of the spinal injury, the cardiovascular symptoms will become more severe (Shaikh et al., 2016).

As the spinal shock (loss of any neural activities below lesion) resolves, the sympathetic activity will slowly return, and may result in improvement of heart rate at quickest within 2 weeks after injury. Without clear pathophysiology, few of those patient will have prolonged bradycardia. Almost 16% of these will suffer cardiac arrest. Cardiovascular complication leads pneumonia and sepsis as the the most frequent complication in spinal cord injury. Although most patient can be manage using pharmacological modalities, asystole incidence are higher compare to those with cardiac pace maker. Some reports found cardiac pace maker in these cases put a relatively minimal risk when compared with benefits in the prevention of life-threatening bradyarrhythmia and asystole (Karim et al., 2020; Shaikh et al., 2016; Wecht et al., 2020).

CONCLUSION

This rare case report has underscored the potential for cervical spinal injuries which considered stable may also lead to serious complication such as prolonged bradycardia and

heart failure. No abnormalities in MRI scan does not rule out a cord injury especially if neurogenic and or spinal shock present. Although neurogenic shock generally resolve within few weeks, few cases of prolonged bradycardia may warrant a cardiac pace maker as a mean to avoid cardiac arrest and other complication. To conclude, this case report underscores the awareness about complication and its management regarding vertebral fracture and spinal cord injury for other physician.

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