Paraplegia After Off-Pump Coronary Artery By-Pass Grafting

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Abstract- Paraplegia is an exceedingly rare neurologic complication after off-pump coronary artery bypass graft (OPCAB) surgery commonly caused by spinal cord ischemia (SCI). SCI is not a well unknown clinical phenomenon in the postoperative course. SCI has been reported after noncardiac surgery in otherwise healthy subjects in whom only one risks factor i.e. severe hypotension has been documented. SCI has also been reported as a rare complication among the other neurologic sequels of cardiac surgery. We report a case of paraplegia in a patient with metabolic syndrome and multiples risk factors after an OPCAB. This patient may be considered as an interesting case as no any ischemic event was found in the imaging modalities and culprit lesion may be attributed to 1-left internal thoracic artery use as an important blood perfusion to anterior spinal artery vasculature and 2-Disc herniation at intervertebral space of T as a culprit lesion 3-transient intraoperative hypotension. The patient was managed by lower extremities physiotherapy and skin care, however, after 3months of follow-up, no evidence of recovery was detected.

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Introduction

SCI is the rarest and the most disabling complications of OPCAB. However, frequently reported in the arch and descending thoracic aortic surgery but any intervention including, orthopedic or cervicofacial, plastic or general surgery may be associated with this lesion (1). The common risk factor between all of this condition is hypotension. Other factors such as use of left internal mammary artery (LIMA), IABP (Intra-aortic balloon pump) insertion, calcification of the aorta, the loss of collateral perfusion to medulla by LIMA harvesting, and compression of spinal cord by intervertebral disk protrusion and accidental injury of spinal cord during intubation, neck hyperextension or improper position, and injury during the regional anesthetic blockage or subdural hematoma (2). Singh reported 4 cases of patients (cholecystectomy, total hip replacement and two cases of face lifting) who developed SCI of severe hypotension etiology in the postoperative course. The study of Singh *et al*., suggests that the Adamkiewicz artery is vulnerable to hypotension episode during surgery (2). Adamkiewicz artery is most important artery in the anterior medulla perfusion (3). We report a case of postoperative paraplegia after elective OPCAB surgery because of multiple risk factors such as diffuse peripheral vascular disease, diabetes, hypertension, chronic renal failure, intraoperative hypotension, internal mammary harvesting and thoracic disc protrusion. The magnetic resonance imaging (MRI) of the brain, thoracic and cervical spinal cord was unremarkable except for herniation of C3-4 and C6-7.

Case Report

A 70-year-old, man undergone an elective OPCAB for chronic stable angina with the use of LIMA. His past medical history except for hypertension, diabetes, peripheral vascular disease, chronic renal failure (non-dialytic) and myocardial infarction was unremarkable. During the preoperative neurologic examination, no evidence of peripheral or central nervous system abnormality was detected. The patient scheduled for OPCAB surgery. Anesthesia was induced with sufentanil, and atracurium and maintained by, propofol, midazolam, and sufentanil. The intubation was softly performed without any evidence of difficult intubation, trauma to oral organs or need to perform a Hyperextension maneuver. The lung ventilation was continued with 60% oxygen and air, so the arterial saturation was maintained between 97-98 %. A central venous line via the right subclavian vein was inserted without any problem. After intubation, the neck was

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positioned in a mild extension state, and a roll sponge was put under his upper trunk to maintain an easy and straightforward midline sternotomy. The sponge was gelatinous and composed of polyurethane material. OPCAB was performed via midline sternotomy and LIMA harvesting. During OPCAB, the mean blood pressure was maintained at a level of 80 mm Hg or more, by using alpha receptor stimulation by phenylephrine, however a short time of hypotension (two minutes, 60/40 mm Hg) was documented during bypass of the left circumflex coronary artery. Blood gas analysis, such as Pao_2 $Paco_2$, was maintained to a normal level. On admission to the intensive care unit (ICU), the anesthetic agents were discontinued and with the absence of hemodynamic instability, or active bleeding or serious arrhythmias and when the patient became awoke he weaned from the mechanical ventilator. During the weaning, his hemodynamic status was stable, and he softly adapted the weaning process. The amount of postoperative drainage during first, second and third days of operation was 700 ml, 400 and 200 ml subsequently. The volume of transfusion was 1200 ml of packed blood cells. The patient was conscience at the following morning, without any complaint of the motor and sensory deficit in his lower extremities. During next 48 hours of surgery, no any remarkable change in hemodynamic was reported. 60 hours after the arrival at ICU, the subject was found to have a flaccid paraplegia in both of his legs. Neurological examination showed a flaccid, and areflexic paraplegia associated with the absence of sensation in both lower extremities and muscle weakness (graded 1 out of 5) with reduced reflexes. Anesthesia was detected at the level of the umbilicus. His upper limbs were neurologically intact. Regard to the Frankel classification of paraplegia; the subject was considered as Grade a (deficit of sensation and absence of voluntary motor function. Computed tomography (CT) scan revealed no intracranial culprit. Past medical history, showed that he had thoracic spine degenerative change, with symptoms of intermittent pain in both legs that treated episodically by non-steroidal anti-inflammatory drugs. No preoperative MRI was available and postoperative MRI of the brain, thoracic and cervical spinal cord was unremarkable except for herniation of C3-4 and C6-7" (Figure 1,2,3,4,5). However consultation with a neurosurgeon lead to planning, an emergency anterior the C3-C4 spines discectomy but the patient's family denied the surgery and vertebral excision, and intervertebral fusion was not performed, The patient had received neurolysin, a radical scavenger, and physiotherapy, and rehabilitation. His recovery was poor during the next three months, but some improvement was observed after 4^{th} months of the event so by 6^{th} months of surgery, his lower extremity strength was graded 1 out of 5, and some improvement in his sensory function had observed.

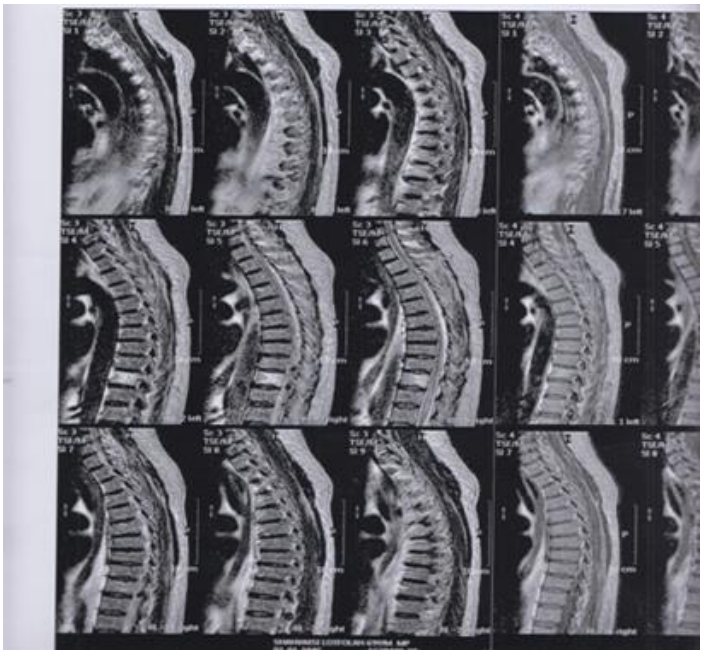

Figure 1. Shows cervical and thoracic spine

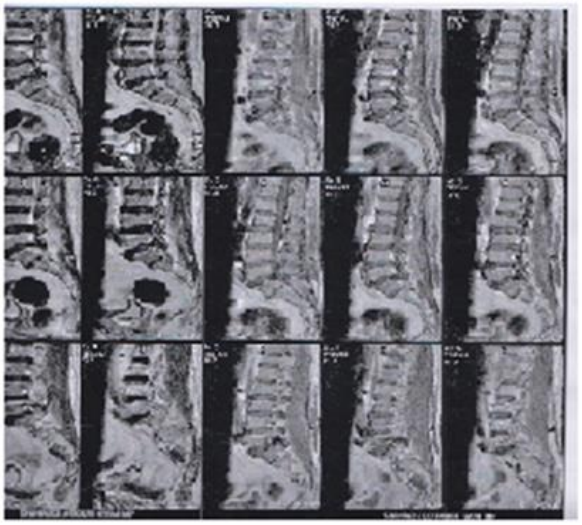

Figure 2. Shows lumbar and distal thoracic spine

Figure 3. Shows incidental finding of a hemangiomatosis of T11

Figure 4. Shows intervertebral disc herniation in C3-C4 and in C6-C7

Figure 5. Shows compression of spinal cord in C3-C4 and C6-C7

Discussion

The first case series of paraplegia was described in 1974 when 11 subjects with various etiologies had been studied. In only one of the cases, the lesion caused by complete blockage of the descending aorta by a large embolus in bifurcation of aorta and in the remaining of the other patients, the lesion resulted from a severe hypotension; in these ten patients, there was a serious co-moribund disease such as noncardiogenic shock by suicide attempts or cardiogenic shock by bleeding and hypovolemic shock (4,5,6,7,8). However, the etiology of the neurologic complication of OPCAB was impossible to delineate in postoperative course but some known causes such as, spinal cord and medulla ischemia, epidural bleeding, and trauma to spinal cord by hyperextension of neck during intubation or poor position of upper trunk by direct compression by sponge roll are worth for differential diagnosis (9,10,11,12). OPCAB, s related spinal cord ischemia should be related to prolonged intraoperative or postoperative hypotension, or blood pressure fluctuation, or embolic accident or aortic wall injury as a late complication of femoral angiography. In our case, blood pressure fluctuation was not documented during surgery, and his blood pressure was maintained at more than 80 mm Hg during OPCAB. In opposed to the middle thoracic spinal cord, upper and lower spinal cord is less vulnerable ischemia. Indeed, in almost all previous cases in the medical literature that occurred after cardiac operation irreversible. Spinal ischemia detected in the middle segment of thoracic spinal cord, the zone that supplied by lower and upper spinal arteries (13,14,15,16). In addition, some cases of spinal cord infarction was supposed to be caused by insertion of an Intra-aortic balloon pump (IABP), some type of primary aortic dissection, dissection caused by aortic cross-clamp, severe hypertension or severe hypotension (17,18,19). In our case, there was no evidence of aforementioned causes that could predispose to spinal infarction. The MRI modality also excluded traumatic causes of the spinal cord or compressive effect of epidural hematoma on the cord. The postoperative MRI revealed spinal cord compression by disc protrusion at the levels (C3-4 and C6-7) medullar zone. In Bondurant *et al.*, classification three categories of MRI images have been described in spinal cord ischemia (CIS). In Type 1 CIS, a decreased signal activity that compatible with acute bleeding was detected. In Type 2 CIS high signal intensity consistent with an acute spinal cord ischemia and edema was observed. In Type 3 CIS, a mixed signal of a central hypo-intensity and a peripheral hyperintensity compatible with acute confusion was detected. The authors concluded that type 2 complication had a rate of recovery and prognosis than Type 1and 3. They supposed that extended position of the neck during cardiac surgery might aggravate a preexisting spinal backbone lesion to produce cervical injury in this case (20). The most common cause of intraoperative spinal cord ischemia is a cervical spinal injury by Hyperextension of the neck during intubation or prolonged extension of the upper trunk by use of gelatin roll in almost all cases of cardiac surgery. The second most important cause of spinal injury during cardiac surgery is irreversible spinal cord ischemia that may be developed by a wide variety of etiologies such an embolus, direct injury of the aorta by catheterization, angiography or insertion of intra-aortic balloon pump (21). Although delineation of the basic pathophysiology of this lesion in our case was difficult to detect, it seems possible that two different mechanisms may be involved in occurrences of cord ischemia, i.e. traumatic injury and ischemic event. Systemic hypotension or hypertensive crisis, malperfusion of Adamkiewicz artery by dissection or other types of hypotension such a tamponade (22). The careful literature review showed less than handful cases of paraplegia and tetraplegia had occurred following CABG, however numbers of IABP induced paraplegia was less than 6 cases. Only one case of paraplegia was developed by tamponade (20). Sanderson reported eight cases of non-traumatic paraplegia that none of them occurred in the post CABG period (21). The careful literature review showed that, there were few cases with apparent etiology of acute onset of paraplegia. In two cases, paraplegia developed by bending forward and subsequent cord injury (16). In one case, the lesion developed by fixation of the head to the MRI instrument (22), in another case it was produced by sudden left side rolling of head on the bed (18) and in the last case, it was associated with a prolonged labor (19). These phenomena may contribute to the posterior herniation of the intervertebral disk, which in turn led to the compression and ischemia of the spinal cord that intraoperatively had hypo-perfusion of spinal cord (23).

In conclusion, we report a rare case of cervical spinal cord infarction after OPCAB. Although delineation of the basic pathophysiology of this lesion was difficult to detect, it seems possible that two different mechanisms may be involved in occurrences of cord ischemia, i.e. traumatic injury and ischemic event It seems that the extension of the thoracic spine by preoperative position

of the patient loosened the force of the posterior para spinal ligament. Posterior para spinal ligament injury not only increases listhesis (posterior movement) of the spine, but also increased the risk of injury in an ischemic cord with compression of the spinal cord. Excessive back extension in operation or changing the position of the thorax in a preoperative era or lateral bending during patient, s transfer in combination with loss of para spinal muscle support by anesthetic drugs may increase spinal cord injury risk. Coexisting thoracic spine disease, such as spondylolysis, herniation of the disc, and canal stenosis, are not rare in the CABG patients, which raises the probability of spinal cord ischemia during open heart surgery. In our case, the past history of thoracic spine stenosis led us to consider a pre-existing lesion within the cervical cord.

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