IJSPT

CASE REPORT

AORTIC INJURY DUE TO PARAGLIDING: A CASE REPORT

Kazuhiko Omori, MD, PhD[1]
Kei Jitsuiki, MD[1]
Takashi Majima, MD[1]
Ikuto Takeuchi, MD[1]
Toshihiko Yoshizawa, MD[1]
Kouhei Ishikawa, MD[1]
Hiromichi Ohsaka, MD, PhD[1]
Keiichi Tambara, MD, PhD[2]
Youichi Yanagawa, MD, PhD[1]

ABSTRACT

A 64-year-old male fell from an altitude of 10 m while paragliding after stalling due to the wind. The purpose of this case report is to describe the outcomes after multiple injuries sustained during a paragliding accident, including a potentially life-threating injury to the thoracic aorta. The subject sustained a bite wound on his tongue, injuries to his chest (left side) and back, and a right forearm deformity. Enhanced whole body computed tomography (CT) revealed fractures of the bilateral laminae of the second and third cervical bones, right first rib, the tenth thoracic vertebral body (compression type), second lumbar vertebral body (burst type) and the right radius, Other injuries included an injury to the thoracic aortic arch and the presence of intraabdominal fluid collection without perforation of the digestive tract. Endovascular treatment was selected for the aortic injury because of multiple injuries. Immediate management included hypotensive rate control therapy using calcium and a beta blocker. On the fourth hospital day, the subject underwent deployment of a stent-graft to the aorta and subsequent surgical immobilization for the lumbar burst fracture. He also underwent surgical immobilization of the radial fracture and was discharged on the 28th hospital day. First responders or physicians should consider the possibility of aortic injury when treating patients who suffer falls while paragliding and provide appropriate management. Failure to provide appropriate management of an aortic injury could result in death.

Level of Evidence: 4

Key words: Aortic injury; multiple fractures; paragliding

[1] Department of Acute Critical Care Medicine, Shizuoka Hospital, Juntendo University
[2] Department of Cardiovascular Surgery, Shizuoka Hospital, Juntendo University

CORRESPONDING AUTHOR
Youichi Yanagawa
1129 Nagaoka, Izunokuni City, Shizuoka, Japan 410-2295
Tel: 81-55-948-3111
E-mail: yyanaga@juntendo.ac.jp

INTRODUCTION

Paragliding is an increasingly popular hobby, as people try to find new and more adventurous activities.[1] There are many recreational and competitive paragliding events held throughout the world. However, there is also substantial and inherent danger with this sport. For this reason, as well as the inexperience of many operators, injuries occur frequently.[1] The role of the sports physical therapist (PT) is typically as a part of the sports medicine team, often being present during performance of recreational sports. The PT can assume the role of an emergency medical responder (EMR) whose primary role is the management of individuals in emergency type situations.[2] In this role, the PT must be prepared to handle any type of emergency situation, which may occur related to medical conditions and/or acute orthopedic/sports injuries.[2]

Injuries sustained while paragliding tend to occur at the spine, pelvis and lower extremities.[3-5] Lautenschlager et al analyzed 86 injuries associated with paragliding in a prospective study and found that 60% of all accidents happened during the landing phase, 26% at launching and 14% while in-flight.[3] The purpose of this case report is to describe the outcomes after multiple injuries sustained during a paragliding accident, including a potentially life-threating injury to the thoracic aorta.

CASE PRESENTATION

The subject of this case report is a 64-year-old male fell who from an altitude of 10 m while paragliding, after stalling due to the wind. A physician-staffed helicopter was called to transport the subject after his accident. On arrival at the hospital, the subject was conscious with a blood pressure of 140/98 mmHg, heart rate of 78 beats per minute, SpO_2 of 100% under 10 L/minute of oxygen delivered via a reservoir mask, and a body temperature of 36.5˚C. He had a bite wound on his tongue, displayed tenderness to palpation of the left side of the chest and the back, as well as a right forearm deformity.

Sonographic assessment for trauma showed fluid collection in his mesentric interval. A biochemical analysis of the blood revealed leukocytosis (12,600/µL) and increased creatinine phosphokinase level (401 IU/L) and D-dimer levels (135.7 µg/mL). Enhanced whole body computed tomography (CT) revealed fractures of the lamina at the second and third cervical vertebrai, right first rib, tenth thoracic vertebral body (compression type), second lumbar vertebral body (burst type) and right radias, Additionally, a thoracic aortic arch injury and intraabdominal fluid collection were noted. (Figure 1)

Immediate management included hypotensive rate control therapy using calcium and a beta blocker, targeting a systolic blood pressure of 80 mmHg for prevention of rupture of the aorta. Endovascular treatment was also selected for the aortic injury because of the presence of multiple injuries. On the day of his injury, the subject was restless and therefore was intubated using a sedative. On the fourth hospital day, he underwent deployment of a stent-graft into the aortic arch by an endovascular specialist who was invited from another hospital. The following day, he underwent posterior fixation of the lumbar burst fracture by the orthopedic surgeons and was extubated on the sixth hospital day. Follow up ultrasound and CT imaging showed that the fluid collection in his abdomen had resolved, so the subject was allowed to begin eating and also to begin inpatient rehabilitation including muscle strength training, balance training and ambulation training. Of note, rehabilitation was not the emphasis of this case report, thus, is not described in detail. After undergoing plate fixation for the radial frac-

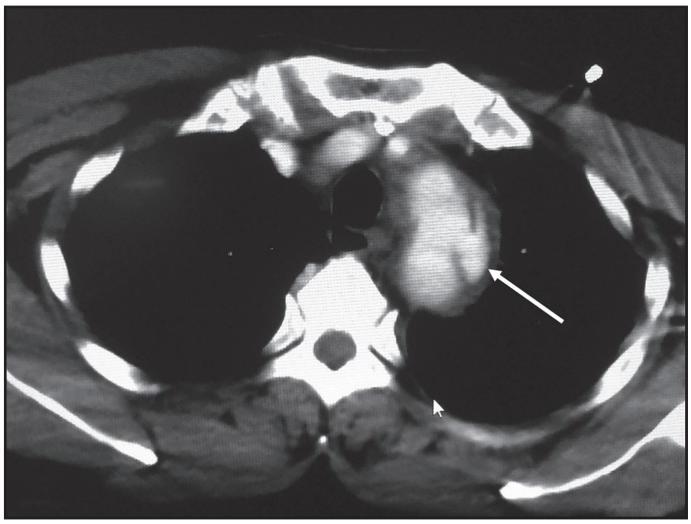

Figure 1. *Enhanced chest computed tomography (CT) on arrival. The CT scan shows pseudo-aneurysm at the aortic arch (arrow).*

ture, he was discharged on the 28th hospital day to home, independently.

DISCUSSION

Cause of injury

By necropsy, approximately 10% of automobile accidents or falls from aircrafts result in fatal aortic injury, indicating that aortic injury must be considered in fatal high-energy accidents.[6,7] Regarding the natural history of aortic injury, Parmley evaluated 296 cases of blunt aortic injury in young soldiers and found that about 15% survived long enough to get to a hospital.[8] Of this 15%, 99% would have died without surgical intervention; 15% of these subjects would have survived only the first hour, 30% the first six hours, 49% the first 24 hours. Seventy-two percent would have died within eight days, and 90% within 4 months.[8] The mechanism of blunt aortic injury remains the most important factor in establishing the diagnosis, with falls from over three meters representing a major source of this injury. During paragliding, pilots fly well over three meters from the ground, so falling while paragliding carries a risk of sustaining blunt aortic injury. In a previous report concerning fatal accidents due to paragliding, aortic injury was reported in addition to head, cervical cord injury, and lung rupture.[3,5,9]

Blunt trauma can damage the thoracic aorta by several mechanisms. The most commonly described cause of rupture is the differential forces set up within the chest by deceleration in either the horizontal or vertical plane.[6,10] The descending aorta remains fixed to the posterior chest wall, while the heart and ascending aorta swing forward and tear free at the isthmus. Given that the present subject had thoracic and lumbar fractures, which are frequently induced by energy through the vertical plane, the aortic injury was presumably caused by a mainly vertical trauma due to a fall from a height.[11] Aortic arch injury has been reported following a fall due to an airplane accident.[7]

Signs and Symptoms of Aortic Arch Injury in the Prehospital Setting

Some clinical features that suggest the presence of blunt thoracic aortic injury include hypotension, upper extremity hypertension, bilateral lower extremity pulse deficit, and initial chest tube output of >750 mL of blood.[12] Patients with this presentation have a high incidence of other significant injuries. However, these clinical features are unreliable for diagnosis of aortic injury as their absence cannot *exclude* the presence of the blunt aortic injury.[12] Thirty percent of patients with this injury have no external signs of chest trauma while 75% have rib fractures that draw attention away from the concomitant intrathoracic injury.[12] The subject of the present case had chest pain due to rib fracture and multiple significant spinal injuries due to the high-energy accident, thus any first responder should have treated this case as a potential blunt thoracic aortic injury.

Appropriate Care of the Victim in the Prehospital Setting

A first responder treating a patient who sustained injury due to paragliding must consider some important key points. Michetti et al reported that overall mortality with aortic injury was 92% and prehospital mortality was 63%.[13] Thus, first the provider should always consider the possibility of an aortic injury, which can be lethal. Second, the provider should address the patient's airway, breathing, and circulatory status. If the patients goes into cardiac arrest, immediate basic life support must be provided, and the automated external defibrillator be used as indicated, after activating the emergency response system. Third, if able, induce hypotension by limiting prehospital intravenous fluid administration and using nitrates, which may result in increase of survival rates for this type of patient with a rupture of the aorta.[14] Providing pain control and gentle treatment during stabilization so that he patient does not sustain an increase blood pressure. Finally, transport the patient to a trauma center as quickly as possible, as patients with aortic injury taken to a trauma center had significantly lower mortality than patients taken to a non-trauma medical center.[13]

The Radiologic Findings Upon Hospital Admission

The first examination is typically includes plain radiography. A widened mediastinum, blurred aortic contour, and irregular aortic arch may be visible on chest X-ray, and are typical image findings in cases

of thoracic aortic injury. However, the sensitivity of chest X-ray in the detection of aortic injuries is not high.[15,16] Thus, additional imaging is warranted, and Computerized Tomography (CT) of the chest with intravenous contrast is strongly recommended for the diagnosis of clinically significant thoracic aortic injury.[17] In the present subject, the chest X-ray only showed minor aortic arch irregularity; however, enhanced CT clearly demonstrated the greater extent of the aortic arch injury.

APPROPRIATE CARE IN THE EMERGENCY ROOM

For all traumatized patients, vital signs should be stabilized by initiating appropriate supportive therapy, rapidly identifying life-threatening injuries using radiography, ultrasound imaging, and enhanced CT. Organizing the trauma team within the emergency room to administer definitive therapy efficiently is of utmost importance. The subject of this case report had stable vital signs but significant, potentially lethal injuries were found on the whole body enhanced CT. The thoracic aortic injury was prioritized for treatment, as it is potentially the most lethal. Accordingly, the management included permissive induced hypotension and rate control therapy, in addition to pain control in the emergency room.

TREATMENT PLAN

Among the multiple injuries in the present case, the thoracic aortic injury was the most lethal; thus, the immediate goal was to repair the aortic injury. Blunt aortic injury used to be treated by open repair. Recently, however, less-invasive treatment via endovascular stent graft has been performed.[18] A meta-analysis of retrospective cohort studies indicated that the procedure-related mortality, overall 30-day mortality and the risk of postoperative paraplegia were significantly lower with endoluminal repair than with open repair.[19] This treatment is especially indicated in the presence of multiple injuries, as open repair requires an artificial heart lung apparatus with heparin administration, which can induce bleeding in other traumatic injury sites.[20] Accordingly, endovascular treatment was selected and obtained a favorable outcome. After repairing the aortic injury, a lumbar burst fracture was the next obstacle to obtaining early functional rehabilitation. Accordingly, immobilization of the lumbar spine was performed soon after confirming the absence of complications of the endovascular stent graft. In the present subject, the intraabdominal fluid collection suggested an intraabdominal injury which was of concern to the medical team, however, this resolved spontaneously. The radial fracture was subsequently stabilized in an elective surgery.

REHABILITATION PLAN

Before the repair of the aortic injury in the present case, the patient was strictly confined to bed because a rupture of the aortic injury had the potential to result in sudden death. In addition, the subject had sustained a lumbar burst fracture; thus, postural change was not allowed based on the instructions of the orthopedist. A pressure dispersing bed was used to prevent integumentary break down. After repairing the aortic injury, passive motion of upper extremities was started by nurses to prevent contracture. After the surgical stabilization of the lumbar fracture, postural change and passive motion of all extremities commenced (subject remained in a cervical orthosis) by nurses. After extubating the patient and confirming the disappearance of the fluid collection in his abdomen, physical therapy ensued to increase the subject's, sitting balance, transfer abilities, standing balance and gait, and muscle strength. Each of these interventions was provided depending on recovery of the subject's function and degree of pain. The rehabilitation program, which was determined based on thorough individualized assessment of his specific problems, allowed the patient to obtain functional ambulatory independence by the time that he was discharged.

CONCLUSION

A first responder or physicians should pay attention to the possibility of lethal aortic injury when treating patients who suffer falls while paragliding (or from subststantial heights in other circumstances) and provide appropriate management. Although not common, such an injury could be life threatening and should be considered a priority in post-traumatic management.

REFERENCES

1. Fasching G, Schippinger G, Pretscher R. Paragliding accidents in remote areas. *Wilderness Environ Med*. 1997;8(3):129-33.

2. Smith DD, Schuemann T, Hoogenboom BJ. The role of the sports physical therapist-marathon events. *Int J Sports Phys Ther*. 2013;8(4):531-6.
3. Lautenschlager S, Karli U, Matter P. Paragliding accidents--a prospective analysis in Swiss mountain regions. *Z Unfallchir Versicherungsmed*. 1993;Suppl 1:55-65. in German
4. Fasching G, Schippinger G, Pretscher R. Paragliding accidents in remote areas. *Wilderness Environ Med.* 1997 ;8(3):129-33.
5. Rekand T. The epidemiology of injury in hang-gliding and paragliding. *Med Sport Sci*. 2012;58:44-56.
6. O'Conor CE. Diagnosing traumatic rupture of the thoracic aorta in the emergency department. *Emerg Med J*. 2004 ;21(4):414-9.
7. Pezzella AT. Blunt traumatic injury of the thoracic aorta following commercial airline crashes. *Tex Heart Inst J*. 1996;23(1):65-7.
8. Parmley LF, Mattingly TW, Manion WC, Jahnke EJ. Nonpenetrating traumatic injury of the aorta. *Circulation.* 1953;17:1086–101.
9. Sato T, Maze Y, Tenpaku H. Delayed surgical treatment of traumatic injury of the thoracic aorta. *Kyobu Geka*. 2004 ;57(12):1117-20. in Japanese
10. Schrøder Hansen K, Våge V, Morild I. Vertical shear forces and their influence on disruption of the diaphragm and thoracic aorta. *Eur J Surg*. 2001;167(7):548-51.
11. Postma IL, Oner FC, Bijlsma TS, et al. Spinal injuries in an airplane crash: a description of incidence, morphology, and injury mechanism. *Spine*. 2015 ;40(8):530-6.
12. Ho AF, Chua TW, Seth P, et al. Atypical presentation of traumatic aortic injury. *Case Rep Emerg Med*. 2014;2014:864301.
13. Michetti CP, Hanna R, Crandall JR, Fakhry SM. Contemporary analysis of thoracic aortic injury: importance of screening based on crash characteristics. *J Trauma*. 2007;63(1):18-24.
14. van der Vliet JA, van Aalst DL, Schultze Kool LJ, et al. Hypotensive hemostatis (permissive hypotension) for rupturedabdominal aortic aneurysm: are we really in control? *Vascular*. 2007;15(4):197-200.
15. Gutierrez A, Inaba K, Siboni S, et al. The utility of chest X-ray as a screening tool for blunt thoracic aortic injury. *Injury*. 2016 ;47(1):32-6.
16. Ekeh AP, Peterson W, Woods RJ, et al. Is chest x-ray an adequate screening tool for the diagnosis of blunt thoracic aortic injury? *J Trauma.* 2008 ;65(5):1088-92.
17. Fox N, Schwartz D, Salazar JH, et al. Evaluation and management of blunt traumatic aortic injury: a practice management guideline from the Eastern Association for the Surgery of Trauma. *J Trauma Acute Care Surg*. 2015 ;78(1):136-46.
18. Khoynezhad A, Azizzadeh A, Donayre CE, et al. RESCUE investigators: Results of a multicenter,prospective trial of thoracic endovascular aortic repair for blunt thoracic aortic injury(RESCUE trial). *J Vascular Surg* 2013; 57(4):899-905.
19. Xenos ES, Abedi NN, Davenport DL, et al. Meta-analysis of endovascular vs open repair for traumatic descending thoracic aortic rupture. *J Vasc Surg*. 2008;48(5):1343-51.
20. Brand S, Breitenbach I, Bolzen P, Petri M, Krettek C, Teebken O. Open repair versus thoracic endovascular aortic repair in multiple-injured patients: Observations from a level-1 trauma center. *Arch Trauma Res*. 2015;4(4):e27183.