

## Case Report

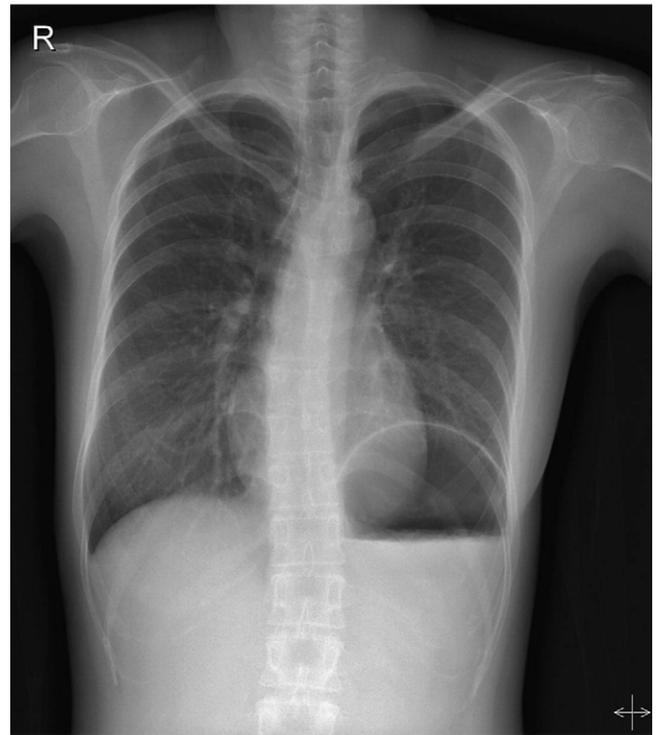
### Spontaneous diaphragmatic rupture complicated with perforation of the stomach during Pilates

#### Abstract

Diaphragmatic rupture (DR) is most commonly seen after a blunt trauma. It rarely occurs spontaneously. Many cases of spontaneous DR followed by strenuous sports activity have been reported in the medical literature. However, there has been no previous report on a case of spontaneous DR after a static sport activity. We report the case of a 29-year-old woman who presented to the emergency department (ED) with pain in the epigastric area that started 1 day before visiting the ED during deep breathing in Pilates. The radiography and computed tomography of her chest demonstrated a left diaphragmatic rupture complicated with the perforation of viscera. She immediately underwent left thoracotomy. In addition, primary repair of the diaphragm and stomach was performed. On the basis of our findings, we conclude that spontaneous DR may be caused by a static sport activity, such as Pilates, causing a serious life-threatening condition.

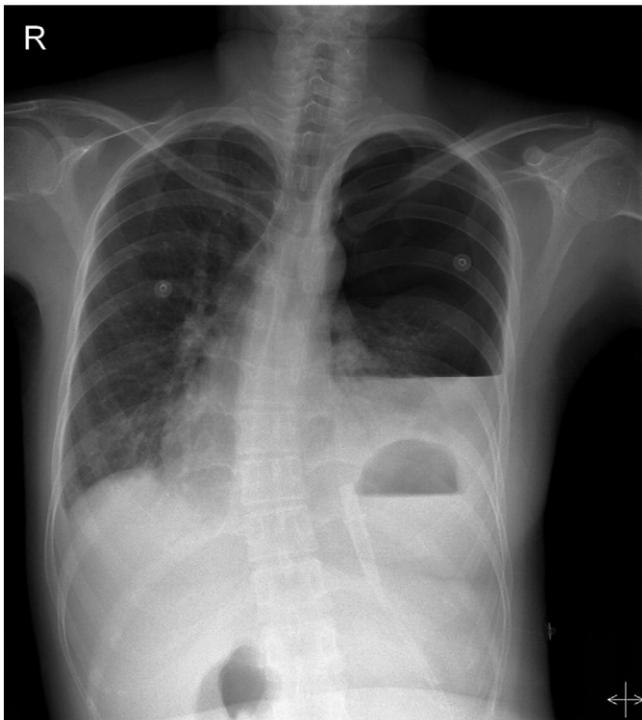
Diaphragmatic rupture (DR) is commonly observed after a blunt trauma to the abdomen and chest. However, spontaneous DR is a rare condition and is attributed to various factors [1-6]. Diagnosing DR in its early stage is very difficult; a delayed diagnosis will result in increased morbidity and mortality [1]. We are the first to report a case of spontaneous DR complicated with perforation of the stomach during Pilates.

A 29-year-old woman visited the emergency department (ED) reporting pain in the epigastric area. The patient's complaints started 1 day before visiting the ED during deep breathing in Pilates. The patient reported that after deep breathing, she felt a stabbing pain in her epigastric area that had become progressively worsened. She had no prior history of an abdominal or chest trauma. On admission, the patient's vital sign was stable and chest radiograph showed an elevated left diaphragm (Fig. 1). Further laboratory findings revealed no other pathologies except a white blood cell count of 16 010/dL. She was treated with H<sub>2</sub> blocker and a pain killer for gastritis or musculoskeletal pain. She was sent home but returned to the ED the following day with worsened pain and shortness of breath. On admission, her abdomen was distended



**Fig. 1** Chest PA at admission, showing an elevated left diaphragm.

with tenderness. However, rebound tenderness was not observed. On chest auscultation, there was no breathing sound over the left hemithorax. The laboratory findings were remarkably elevated for white blood cell count (23 050/dL) and C-reactive protein (6.76 mg/dL). The follow-up chest radiograph revealed pneumothorax and pleural effusion in the left hemithorax (Fig. 2). The patient underwent tube thoracostomy using a trocar. Foul-smelling discharge and food material were drained from the chest tube. Urgently, a thoracoabdominal computed tomographic scan was obtained, which revealed air-fluid level of the stomach located in the left hemithorax (Fig. 3). She immediately underwent a left thoracotomy. The recent rupture of 7 × 5 cm in the left posterior, medial diaphragm, and a perforation of the anterior gastric body were observed. Primary repair of the diaphragm and stomach was performed. After 16 days from the onset, she was discharged without any sequelae.



**Fig. 2** Follow-up chest PA shows pneumothorax and pleural effusion in the left hemithorax.

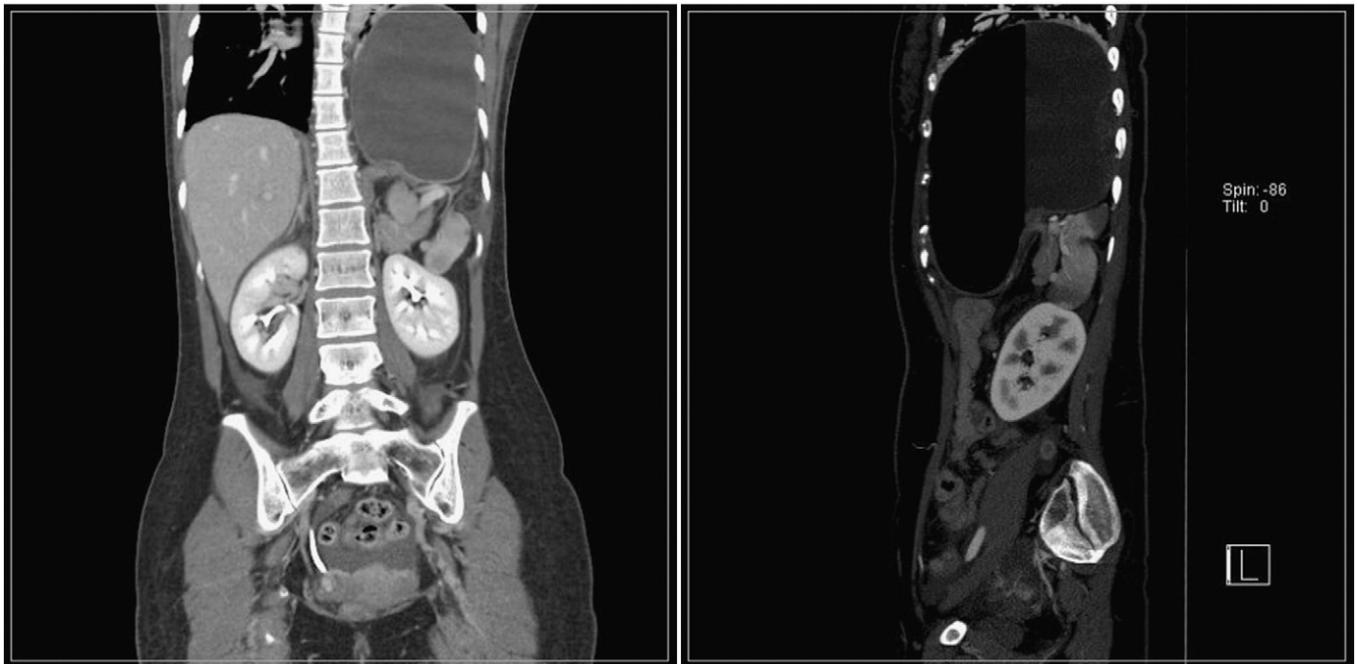
Approximately 1% of DRs are reported to occur spontaneously [2]. Spontaneous DR was caused by a sudden increase in abdominal pressure resulting in a pressure gradient across the diaphragm, such as heavy physical effort, sudden twisting movements, childbirth, and violent cough-

ing [1-5]. Although it was not identified whether our patient had a congenital diaphragmatic anomaly in the ruptured area, the sudden onset of stabbing pain during deep breathing in Pilates and the recently ruptured diaphragm observed by the thoracic surgeon during operation indicated that the rupture occurred spontaneously during Pilates. Although many cases of spontaneous DR followed by strenuous sport activities were reported in the medical literature [3], there has been no previous report of a case of spontaneous DR after a static sport activity, such as Pilates.

Pilates is an exercise developed in the early 1900s that is based on gymnastic, martial arts, yoga, and dance. Unlike yoga, Pilates requires deep abdominal breathing, while keeping the abdomen flat and compressing the lower abdomen from the pelvis using transversus abdominis and pelvic floor constriction [7,8]. As a result, increased abdominal pressure contributes to the rupture of the diaphragm. We believe that this is how our patient was injured.

Chest radiograph is the most valuable diagnostic modality and computed tomography is regarded as second-choice modality for detecting DR [9-11]. Diagnostic chest aspiration and drainage of pleural effusion should not be performed when DR is suspected because they could damage the herniated viscera [12].

Our case showed that a delayed diagnosis of DR may cause a life-threatening condition. It should also be kept in mind that static sport activities may sometimes cause DR. Spontaneous DR should be suspected if there is an abnormal diaphragmatic elevation in a patient who presents with sudden epigastric area pain after a static sport activity, such as Pilates.



**Fig. 3** Abdominal computed tomography scanning demonstrates marked distension and air-fluid level of stomach located in the left hemithorax.

Young Mo Yang MD  
Hee Bum Yang MD  
*Department of Emergency Medicine  
Eulji University  
Daejeon, Korea*

Jung Soo Park MD  
Hoon Kim MD  
Suk Woo Lee MD, PhD  
*Department of Emergency Medicine  
College of Medicine  
Chungbuk National University  
Cheongju, Chungbuk 361-763, Korea  
E-mail address: drrhec@chungbuk.ac.kr*

Jeong Hee Kim BA  
*College of Medicine  
Chungbuk National University  
Cheongju, Chungbuk 361-763, Korea*

doi:10.1016/j.ajem.2009.06.012

## References

- [1] Kara E, Kaya Y, Zeybek R, et al. A case of a diaphragmatic rupture complicated with lacerations of stomach and spleen caused by violent cough presenting with mediastinal shift. *Ann Acad Med Singapore* 2004;33:649-50.
- [2] Gupta V, Singhal R, Ansari MZ. Spontaneous rupture of the diaphragm. *Eur J Emerg Med* 2005;12:43-4.
- [3] Ozguc H, Garip G, Kirdak T. A case of diaphragmatic rupture after strenuous exercise (swimming) and jump into the sea. *Ulus Travma Acil Cerrahi Derg* 2009;15:188-90.
- [4] George L, Rehman SU, Khan FA. Diaphragmatic rupture: a complication of violent cough. *Chest* 2000;117:1200-1.
- [5] McIndoe GA, Hopkins NF. Spontaneous rupture of the diaphragm. *Postgrad Med J* 1986;62:389-91.
- [6] Shah R, Sabanathan S, Mearns AJ, et al. Traumatic rupture of the diaphragm. *Ann Thorac Surg* 1995;60:1444-9.
- [7] Keays KS, Harris SR, Lucyshyn JM, et al. Effects of Pilates exercises on shoulder range of motion, pain, mood, and upper extremity function in women living with breast cancer: a pilot study. *Phys Ther* 2008;88:494-510.
- [8] Levine B, Kaplanek B, Scafura D, et al. Rehabilitation after total hip and knee arthroplasty: a new regimen using Pilates training. *Bull NYU Hosp Jt Dis* 2007;65:120-5.
- [9] Shanmuganathan K, Mirvis SE. Imaging diagnosis of nonaortic thoracic injury. *Radiol Clin North Am* 1999;37:533-51.
- [10] Shanmuganathan K, Killeen K, Mirvis SE, et al. Imaging of diaphragmatic injuries. *J Thorac Imaging* 2000;15:104-11.
- [11] Killeen KL, Mirvis SE, Shanmugannathan K. Helical CT of diaphragmatic rupture caused by blunt trauma. *AJR Am J Roentgenol* 1999;173:1611-6.
- [12] Bekkasy SM, Dave KS, Wooler GH, et al. "Spontaneous" and traumatic rupture of the diaphragm: long-term results. *Ann Surg* 1973;177:320-4.