Case report - Vascular thoracic

Acute aortic dissection occurring during the butterfly stroke in a 12-year-old boy

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Abstract

A 12-year-old boy had severe chest and back pain of sudden onset while practicing the butterfly stroke in a swimming class. Computed tomography revealed an intimal flap in the descending thoracic aorta with massive right hemothorax. A ruptured type B acute aortic dissection was diagnosed, and then he collapsed. We totally replaced the descending aorta with a woven polyester prosthetic graft during deep hypothermic circulatory arrest. Hemostasis was achieved, but consciousness was not regained after operation, and multiple organ failure occurred. He died on the fifth postoperative day. He and his family had no history of cardiovascular disease. It seems that the swimming provoked a severe Valsalva maneuver, raising blood pressure acutely and thereby leading to dissection. This is then analogous to the propensity for dissection during intense isometric exercise such as weightlifting.

Keywords: Acute aortic dissection in children; Butterfly stroke; Swimming

1. Introduction

Acute aortic dissection in childhood is a rare condition that can be associated with many risk factors, including congenital cardiovascular disorders, connective tissue disorders, trauma, and hypertension. We describe our experience with a 12-year-old boy in whom acute aortic dissection developed while he was practicing the butterfly stroke. The patient had no other known risk factors.

2. Clinical case

The patient was a 12-year-old boy who had a history of Epstein–Barr viral infection and surgery for cryptorchidism. He and his family had no history of cardiovascular disease. While practicing the butterfly stroke in a swimming class at his junior high school, he suddenly experienced severe chest and back pain. He first consulted an orthopedist, but no abnormalities were found. He then went to a pediatrician. His height was 150 cm, and the body weight was 50 kg. His physique was muscular and well developed for his age. His consciousness was clear, and systolic blood pressure was 160 mmHg. The patient complained of abdominal pain and was given an enema, with no improvement in symptoms. Finally, enhanced computed tomography revealed an intimal flap in the descending thoracic aorta. Acute aortic dissection was diagnosed. The pediatrician could not diagnose the type of dissection because of motion artifacts caused by the ascending aorta. The left kidney was not enhanced by contrast medium, indicating that the dissection involved the left renal artery. After computed tomographic scanning, the blood pressure dropped to 80 mmHg, and the patient became drowsy. He was emergently transferred to our hospital for further evaluation and treatment.

On admission, a chest X-ray film showed massive right hemothorax. Computed tomography was therefore repeated. The aortic dissection was found to be Stanford type B and ruptured into the right pleural cavity (Fig. 1). On entering the operating room, the patient collapsed. Standard cardiopulmonary resuscitation was followed by an emergent left thoracotomy, and extracorporeal circulation was started. Transesophageal echocardiography showed that the entry was located just below the left subclavian artery, and the true lumen of the descending aorta was severely narrowed. We found a tear of the adventitia in the lower part of the descending aorta. We therefore totally replaced the descending aorta with a woven polyester prosthetic graft during deep hypothermic circulatory arrest. Because the diameter of the true lumen of the descending aorta was 11 mm, we used a graft 12 mm in diameter. The patient was weaned from cardiopulmonary bypass, and hemostasis was achieved. However, consciousness was not regained after operation, and multiple organ failure occurred. He died on the fifth postoperative day. Histopathological examination of a specimen of the dissected aortic wall obtained during surgery revealed no signs of medial degeneration or necrosis (Fig. 2).
3. Discussion

Aortic dissection is rare in children. Among a total of 1085 cases of dissecting aortic aneurysm, 38 (3.5%) occurred in persons 19 years of age or younger [1]. During a 1-year period, two of 5658 deaths in New York State among persons aged 0–19 years were caused by aortic dissection [1]. Prompt diagnosis may be life-saving because untreated aortic dissection has extremely poor outcomes [1]. Fikar et al. reported that most children with aortic dissection have known predisposing risk factors, such as cardiovascular anomalies, Marfan’s syndrome or other connective tissue disorders, hypertension, trauma, and weight training [1]. Zalzstein et al. reported 13 patients younger than 25 years who had acute or chronic aortic dissections between 1970 and 2000. Congenital cardiovascular anomalies were diagnosed in five of these patients, Marfan’s syndrome in four, and blunt trauma to the chest in three. No risk factors were identified in the remaining patient, a 17-year-old girl [2].

Our patient had been in good health, with no congenital abnormality. Histopathological examination of the aortic wall showed no evidence of medial necrosis or degeneration. Acute aortic dissection occurred in him during the training of the butterfly stroke.

Many reports point out the relationship between aortic dissection and weightlifting [3]. In our patient, it seems that the swimming provoked a severe Valsalva maneuver, raising blood pressure acutely and thereby leading to dissection. This is then analogous to the propensity for dissection during intense isometric exercise such as weightlifting. From the viewpoint of sports medicine, the butterfly stroke might cause shoulder pain and spondylolysis [4], but has not been associated with aortic dissection previously.

The patient’s muscular physique was adult-like, but the diameter of the true lumen of the descending thoracic aorta was only 11 mm. His underdeveloped thoracic aorta might have been relatively frail and susceptible to acute blood pressure rising. Swimming coaches and pediatricians should recognize that hard swimming training like the butterfly stroke is a very rare risk factor for aortic dissection in children.

References


eComment: Is swimming still safe? Ultrasonic cardiac output monitoring under water

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We read with great interest the recent case report by Dr. Uchida and coworkers regarding the fatal outcome of a type B aortic dissection in a 12-year-old butterfly swimmer [1]. Usually, swimming is believed to be a reasonably safe sport [2], where overuse injuries are predominant. Breaststroke events increase the risk for knee overuse injuries more than other disciplines. However, as far as cardiac output in swimmers is concerned, immersion does play a role in this regard.

In deep water immersion, a 100 cm column of water exerts a pressure of 76 mmHg on the body surface which changes to 40–60 mmHg during swimming. This pressure compresses superficial veins resulting in a blood volume shift to the thorax and heart. When immersion is up to the iliac crest, the blood volume shift is not significant, but, on immersion up to the neck, the central blood volume has been shown to be increased by about 700 ml [3]. Planimetry of the diastolic posterior-anterior area of the heart has shown an average increase in heart size of 30% within 6 s.

We studied cardiac output derived by ultrasonic cardiac output monitoring (USCOM) while changing from rest at land to whole body immersion [4]. Cardiac output doubled mainly due to doubled stroke volume, while afterload was reduced by 50%. However, during freestyle endurance swimming, cardiac output was increased up to 15.4 l/min, nearly four-fold in contrast to rest outside the water.
As such, it is conceivable that significant upregulation of cardiac output might at least have influenced the type B aortic dissection in the aforementioned young swimming athlete.

References


eComment: Acute aortic dissection in the young – distinguishing precipitating from predisposing factors

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We read with interest the report of Uchida and colleagues [1]. As reported, acute aortic dissection (AAD) is a rare entity in the young. In most cases of AAD, the pathogenesis is a result of the interplay of three factors – a predisposition provided by an abnormality or weakening of the aortic wall, an agent of intimal injury or tear resulting in the intimalmedial flap, and hemodynamic factors that propagate the dissection once it has been initiated.

Congenital cardiovascular disorder (coarctation, bicuspid aortic valve) remains the most important predisposing factor in young patients whereas long-standing hypertension is the commonest predisposition in adults.

As shown by Uchida’s group [1], AAD can occur without any predisposing factors in young children or adolescents, an indication that the predisposition theory provides only part of the pathogenetic mechanisms responsible for AAD.

We conceptualize that the normal aorta presents a dissection threshold that is commonly not reached by the usual hemodynamic stresses encountered during the cardiac cycle. The tensile strength and elasticity of the aortic wall resides primarily in the media. Predisposing factors render the aorta more vulnerable to dissection by weakening the media. The aorta so weakened presents a lower than normal threshold to dissection. Therefore, the factors that precipitate the onset of AAD need clarification. Several precipitating factors of AAD have been identified by Hatzaras and colleagues [2]. These factors are not necessarily identical with the predisposing factors but they act on the basis of a transient severe hypertensive reaction to precipitate AAD. In their report [2], strenuous physical activity and severe emotional stress were identified as clear precipitating factors of the acute onset of thoracic pain of AAD in 67% of patients. Strenuous physical activities included lifting heavy weights, swimming, snow shoveling, and vigorous sex. Severe emotional stresses included very upsetting news, large financial losses, and extremely stressful business trips.

We believe that AAD occurs when the precipitating factors (on the basis of a transient, severe hypertensive reaction) are potent enough to overcome the dissection threshold of the aortic wall. Clearly, a far more potent inciting event is required to cause AAD in the otherwise normal aorta than in one rendered vulnerable by a congenital or acquired weakness of the aortic wall.

Swimming has been reported to precipitate AAD [2] and triple vessel coronary artery dissection (without concomitant AAD) in the absence of any predisposing factors [3]. Possibly, swimming constitutes a potent inciting event for arterial dissections in certain individuals.

References


eComment: Cardiovascular screening of the young competitive athletes before participating in sports

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In the young competitive athletes, acute aortic dissection is a rare and catastrophic disorder. The intrinsic developmental abnormalities and secondary hemodynamic changes may lead to degeneration of the aortic wall resulting in aortic dissection. A complete cardiovascular screening may be necessary to reveal possible lethal abnormalities that may predispose the young children and adolescents to athletic field catastrophes. Individuals at high-risk for aortic dissection may show the physical features of the Marfan syndrome as tall height and long extremities. As reported by Uchida et al. [1], however, acute aortic dissection may arise without any predisposing factors in a young child athlete.

The occurrence of an unexpected life-threatening event in student-athletes due to unsuspected cardiovascular disease has aroused concern of the public and medical community [2]. Therefore, pre-participation cardiovascular screening may play a role in stimulating considerable interest in such catastrophes. The aims of the pre-participation examination are to detect conditions that may predispose to injury, disability or death, meet legal and insurance requirements, establish the general health of the athlete, provide counsel on health-related issues, and assess the athlete’s fitness for specific sports [3]. On the basis of the available evidence coming from the 25 years Italian experience, pre-participation cardiovascular screening consists of complete personal and family history, physical examination, and 12-lead electrocardiogram in the young competitive athletes [4].

Multiple disciplines including family physician, cardiologist, cardiovascular and orthopedic surgeons, ophthalmologist, and genetic and sports medicine specialists are in charge of care. Parents and athletes should be made aware that pre-participation cardiovascular screening cannot always prevent fatal incidents during sports activity.

References


