

# A Pediatric Case of Exercise Related Transient Abdominal Pain (ETAP) and Analysis of Current Literature

Chengwei Zhang<sup>1</sup>, Chang Amber Liu<sup>2</sup>, Zhenxiang Pan<sup>1</sup> and Jingping Wang<sup>2\*</sup>

<sup>1</sup>Department of Anesthesiology, The Second Hospital of Jilin University, Changchun, Jilin 130041, China

<sup>2</sup>Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA 02114, USA

\*Corresponding author: Jingping Wang, Department of Anesthesia and Critical care and Pain Medicine, Massachusetts General Hospital, 55 Fruit St. GRJ 4-420 Boston, MA 02114, USA, E-mail: JWANG23@PARTNERS.ORG

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## Abstract

Exercise-related transient abdominal pain (ETAP) is an ailment commonly known to athletes as stitch and detrimental to their performance although it is thought of as benign and self-limiting. It may be stabbing or sharp when severe, aching, pulling or cramping when less intense, recurrent, and resistant to treatment. To date, ETAP remains under analyzed and under reported in the medical literature. There is no direct evidence of the cause of this ailment. Most of the patients reported in the previous literature were adult patients. This case report of an 11-year-old otherwise healthy female and subsequent analysis of literature, will present a contemporary understanding of ETAP, including the various ideas about the etiology, the epidemiology associated with it, and strategies to manage and prevent this frustrating disorder.

We present a case report of ETAP in an 11-year-old otherwise healthy female and our management of her ailment to alleviate her symptoms. We also analyze the current literature on ETAP. We present the etiology and epidemiology of ETAP, and strategies to manage this ailment.

## Case Report

An 11-year-old otherwise healthy female presented to the pediatric chronic pain clinic with deep cramping pain in her right upper quadrant which onsets only during certain exercises. She reported onset of pain 3 years ago, first noted on a family hike. She described it as a deep cramp brought on by exercise such as fast walking of more than 20 min, hiking, and horseback riding. If she did not stop activity at the onset of pain, it would progress in severity and last for hours. She denied having any abdominal pain at rest. The pain was not associated with eating, drinking, or going to the bathroom. The patient noted that rest and laying in the fetal position helped to decrease the pain. She did try drinking water and use of heat packs which did not help. The pain was initially thought to be associated with GERD. She had an extensive GI workup which was negative.

Our patient was diagnosed with right upper quadrant mass in utero on prenatal ultrasound and the followup was negative in infancy. She had a full term delivery and subsequent normal growth and development. Her medical history includes this persistent exercise-associated abdominal pain and she is status post adenotonsillectomy and bilateral ear tubes. She had been prescribed Celexa and Gabapentin for her abdominal pain which were stopped due to their adverse side effects including headache, nausea and blurred vision. She lived with her parents, sibling, attended 6<sup>th</sup> grade, and was active in horseback riding. She had possible anxiety according to her pediatrician, but no formal diagnosis. On physical examination, her abdomen was soft, not tender and not distended. She had no hepatosplenomegaly. Muscle tone, strength and sensation were all normal. Other examination showed no obvious abnormalities. Our patient was diagnosed with ETAP. We recommended the non-pharmacologic approach including behavioral changes. Our recommendations included decreasing

## Introduction

Exercise-related transient abdominal pain (ETAP) is an ailment commonly known to athletes as stitch and it is thought of as benign and self-limiting. It was first described in 1951 and has been more carefully studied over past 15 years. Approximately 40–60% of runners at some time experience the performance-diminishing condition of ETAP [1-3]. Stitch, stitch in the side, side ache, side cramp and subcostal pain are terms that have been used to describe ETAP [2,3]. It may be stabbing or sharp in character when severe; and aching, pulling or cramping in character when less intense. It can be recurrent, and resistant to treatment. Although widely known, ETAP remains under analyzed and under reported in the medical literature [3]. There is no direct evidence for the pathophysiology of ETAP. Several theories have been presented to illustrate the mechanism responsible for it. These theories include stress being placed on the visceral ligaments, ischemia of the diaphragm leading to insufficient oxygen supply, muscle cramp, gastrointestinal ischemia, and the irritation of the parietal peritoneum.

PO intake prior to activity, modifying activity at start of pain episode, physical therapy and aquatherapy. Moreover, we recommended topical lidocaine, patch or ointment to the site of pain as needed when the pain is severe. Her symptoms improved and abated over time with these behavioral changes recommended.

## Discussion

ETAP is a well-localized pain mainly related to physical exertion. It is most prevalent in lateral aspects of the mid-abdomen. Right-sided pain has been reported twice as commonly as left-sided pain in all patients, although left-sided pain may be more prevalent among pediatric patients [1,3-7]. Morton and Callister found that ETAP commonly presented in the right middle third of the abdomen (just adjacent to the umbilicus) in 58% of athletes followed by the left middle third (43%) and umbilical area (21%) [3]. Stitch, stitch in the side, side ache, side cramp and subcostal pain are terms that have been used to describe ETAP. Moreover, abdominal pain may be associated with shoulder tip pain (STP) [2].

The exact etiology of ETAP is still unknown although numerous theories have been proposed. These theories include stress being placed on the visceral ligaments, ischemia of the diaphragm responsible for insufficient oxygen supply, muscle cramp, gastrointestinal ischemia or disturbance, and irritation of the parietal peritoneum. Among them, diaphragmatic ischemia and stress on visceral ligaments supporting the abdominal viscera are the two early causes of ETAP that have been most widely accepted in the literature [4,8].

Diaphragmatic ischemia is one of the traditional causative explanations of ETAP. As far back as 1941, Capps proposed this theory [8]. Diaphragmatic ischemia is derived from the shunting of blood from the respiratory muscles to the gut or to the muscles involved in movement [3]. However, no research aiming to quantify the flow rate were successful in demonstrating this reduced supply clearly. Plunkett's study showed that following the ingestion of a large meal, there was no change in diaphragmatic movement under fluoroscopy with those runners experiencing ETAP [9]. Moreover, if the diaphragm was ischemic, lung function would be impaired, especially during inhalation [7]. Above all, although the diaphragm may be involved in ETAP, diaphragmatic ischemia is an unlikely etiology of ETAP. Another early theory for the cause of ETAP is stress being placed on the visceral ligaments including lienophrenic, gastrophrenic and coronary ligaments which connect abdominal viscera, especially the stomach and liver, to the diaphragm [3,9]. Historically, this theory was accepted mainly because it explained several characteristics of ETAP in activities that are jolting in nature yet of low respiratory demand such as horse riding [3,4,10]. Plunkett and Hopkins illustrated that ETAP may be caused by the vertical jolting in such sports as camel riding, horseback riding and driving vehicles "off road" through anecdotal evidence [9]. This theory could also explain the experience of STP as the visceral ligaments attach to the diaphragm. Although stress on visceral ligaments can explain many of features belonging to ETAP, the pain deriving from it is commonly dull, along the midline and not well localized which is in contradiction with the pain of ETAP

being described as sharp, lateral and well localized [3]. Furthermore, this theory cannot account for the cause of the prevalence of ETAP in swimming which is non-jolting and occurs in a prone position [3,8]. Above all, visceral ligament stress theory is not perfect to explain the occurrence of ETAP. In addition to the above two traditional theories, gastrointestinal disturbance has been thought of as a cause of ETAP in several recent literatures [11-13]. The pain may be derived from gut ischemia or distension [10,13-15]. However, this theory also has its shortcomings. Gastrointestinal pain is commonly described as diffuse and colicky which are not similar to ETAP [7,16]. Moreover the pain of gastrointestinal distension is often observed in the subjects without food or drink intake for several hours before exercise [9,17]. Hence, gastrointestinal changes is also an unlikely etiology of ETAP. Muscle cramp may be another theory accounting for ETAP because a considerable number of athletes (27%) describe ETAP as a cramping sensation [3]. However, subsequent investigations convincingly discredited muscle cramp theory through measuring electromyographic (EMG) activity [18-20]. The irritation of the parietal peritoneum is another theory that has been widely accepted because it is consistent with the features of ETAP. The pain arising from parietal peritoneum irritation is also sharp, well localized, similar to ETAP [21,22]. Because the subdiaphragmatic portion of the parietal peritoneum is innervated by the phrenic nerve, the irritation of parietal peritoneum can potentially cause STP. In addition, there is a potential space known as peritoneal cavity between the parietal peritoneum that adheres to the abdominal wall and underside of the diaphragm and the visceral peritoneum that overlays the abdominal viscera. A serous fluid fills in this cavity to alleviate friction between the two layers [23]. Physical exertion and the distension of stomach can accentuate friction between the parietal peritoneum and the visceral peritoneum then induce pain [16]. Further, Monton and Callister reported that this friction may be increased by exercise-mediated changes in the quantity or viscosity of the lubricating serous fluid which is responsive to osmotic gradient in the viscera [3]. Children have a proportionally larger peritoneal surface area than that of adults, hence there is a high prevalence of ETAP in the young [24]. Moreover, pain arising from the parietal peritoneum disappears or relieves after removal of inducement which is similar to ETAP [7]. In addition, the case reports of Dimeo et al. Lauder and Moses, and Leslie also have implicated the parietal peritoneum as the etiology of ETAP [25-27]. In summary, the irritation of parietal peritoneum and, while speculative, friction between the parietal properitoneum and the visceral peritoneum may be a logical explanation for ETAP.

The prevalence of ETAP is different depending on different sports, such as swimming (75%), running (69%), horseback riding (62%) [3]. In our case report, the 11-year-old girl described the pain as a deep cramp brought on by exercise also including horse riding. When age and other personal characteristics known to affect ETAP were controlled for, Morton and Callister found horse riding and running and to be most provocative of the pain [6]. This is consistent with our case.

Management of ETAP includes preventing it from occurring and alleviating pain when it happens. There are several studies

in current literature which proposed some strategies and techniques in treatment of ETAP. These management strategies center around prevention of symptoms and include refraining from ingestion of large volumes of drink and food at least 2 hours prior to sporting event, avoiding drinking hypertonic beverages before exercise, and proper warming up prior to exercise [1,17]. We recommended to our patient to decrease PO intake prior to activity, modify activity at start of pain episode and initiate physical therapy and aquatherapy. To relieve pain when it is present, Morton and Callister reported that the most common techniques were stretching the affected site, bending over forward, deep breathing and pushing on the affected area [3]. Furthermore, the study of Plunkett and Hopkins illustrated that shallow breathing relieved the pain in their subjects [9].

## Conclusion

ETAP is a very common ailment experienced by most athletes and some young persons. Although many studies have focused on the etiology of ETAP in recent years, its etiology is still controversial. Our review of literature and our experience with our patient in this case report concludes that ETAP responds well to behavioral changes rather than pharmacologic treatment.

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