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Avulsion of the Levator Ani in a Young Adult Male by Blunt Trauma

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A young adult male equestrian sustained an avulsion of his levator ani muscle and its bony origin secondary to a horse landing on his groin. Avulsion of the levator ani muscle has, to our knowledge, only been described in obstetric related injuries. We describe the findings on CT imaging of this traumatic blunt injury.

Introduction

Avulsion of the levator ani muscle has, to our knowledge, only been described in obstetric related injuries. We describe the findings on CT imaging of this traumatic blunt injury.

Case Report

A 19-year-old male presented to the emergency room after sustaining an injury related to a horseback riding accident. Per the patient, while riding, the horse reared up onto its hind legs, bucking the patient to the ground, where he landed in a supine position. The horse, having lost its balance as well, fell backward onto the patient, with the horse's back landing directly on the patient's groin. The patient complained of pelvic pain without lower extremity pain or numbness. Based on his presentation, a conventional radiographic trauma series was obtained (i.e. lateral view of the C-spine and an AP view of the chest and pelvis). Findings demonstrated a parasymphyseal bone fragment extending along the left

Figure 1. 19-year-old man with levator ani avulsion. AP radiograph of pelvis shows parasymphyseal bone fragment extending along left pubis (large arrow), mild pubic symphysis diastasis, and transverse fracture of right transverse process (small arrow). There is irregularity along right sacroiliac joint space, suggestive of fracture.

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Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging

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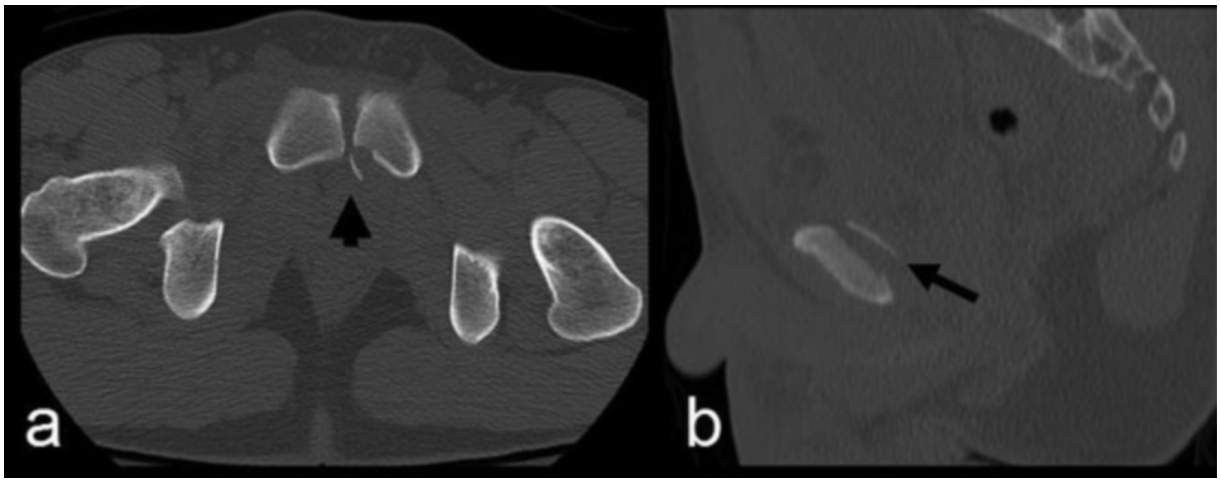
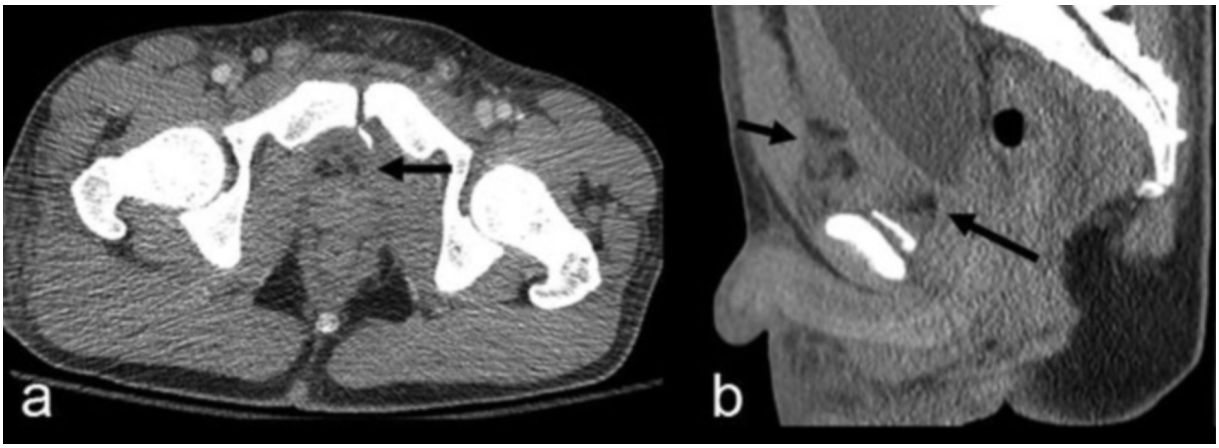


Figure 2 (above). 19-year-old man with levator ani avulsion. CT pelvis in bone window with (a) axial and (b) sagittal views of pelvis demonstrating avulsed fracture of left parasymphsysis (arrows), consistent with levator ani muscle avulsion.

Figure 3 (below). 19-year-old man with levator ani avulsion. CT of pelvis in soft tissue window in (a) axial and (b) sagittal planes showing hematoma in extraperitoneal fat anterior to bladder (arrows) believed to be related to avulsed fracture fragment.



superior pubic ramus (Fig. 1) as well as mild pubic symphysis diastasis. Additionally there was a transverse right sacral fracture as well as a right L5 transverse process fracture. Given these findings, a CT of the bony pelvis was obtained.

The CT confirmed a zone one right sacral fracture, a right L5 transverse process fracture, as well as an avulsion fracture along the posterior aspect of the left parasymphysis, consistent with levator ani muscle origin avulsion (Fig. 2). The patient underwent examination under anesthesia without any definitive surgical interventions performed and was subsequently admitted for monitoring.

Two days after admission, the patient had a drop in his hematocrit from 34 to 18. A CT of the abdomen and pelvis was obtained which demonstrated a hematoma in the presacral space and in the extraperitoneal fat anterior to the bladder (space of Retzius), believed to be related to the parasymphyseal avulsed fracture fragment (Fig. 3). Additionally, there was a hematoma in the left retroperitoneum in the posterior pararenal space. The patient was transfused two units of packed red

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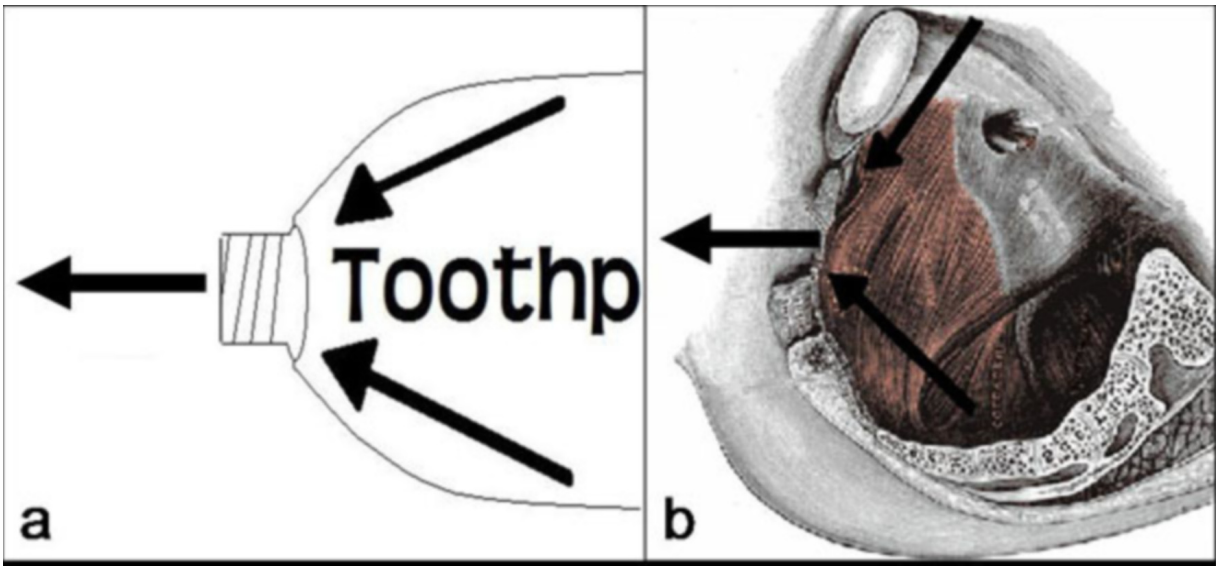

Figure 4. 19-year-old man with levator ani avulsion. Comparison of squeezing tube of toothpaste (a) and pressure applied on pelvis (b), both causing extrusion of contents via path of least resistance.

blood cells with improvement of his hematocrit to only 20. Secondary to lack of response to transfusion, the patient was taken to angiography for arterial assessment. Abdominal aortogram and pelvic angiogram were negative for any actively bleeding vessels. The patient was monitored for an additional five days and over this time period his hematocrit remained stable in the mid 20s. The patient was discharged home in stable condition.

Discussion

The levator ani along with the coccygeus muscle, form the pelvic diaphragm. The levator ani is a broad, thin muscle that sits on the side of the pelvis and unites with its counterpart on the opposite side to form the majority of the pelvic floor [1].

The levator ani is divided into the iliococcygeal and pubococcygeal segments. The origin of the iliococcygeus is the ischial spine and the posterior part of the tendinous arch of the pelvic fascia. Its insertion is the coccyx and anococcygeal raphe. The origin of the shorter and more medial pubococcygeus is the posterior aspect of the pubis and the anterior part of the obturator fascia. The pubococcygeus extends along the side of the anal canal in a nearly horizontal fashion, where it inserts on the coccyx and lower sacrum. The levator ani constricts the lower end of the rectum and in females, the vagina as well. Additionally, it elevates and inverts the lower end of the rectum after it has been protruded and everted during expulsion of feces [1].

Avulsion of the levator ani from its pubic origin, to our knowledge, has only been described in obstetric literature relating to vaginal births [2-10]. The segment of the levator ani muscle involved in these obstetric-related injuries is the pubococcygeus. The most common finding is an avulsion injury to the inferomedial aspect of the pubococcygeus muscle, thus a detachment of the muscle from its origin at the pubis [2, 12]. The injury is associated with a prior difficult intrapartum episode, notably, premature or prolonged maternal voluntary efforts [4] as well as advanced maternal age [5] and macrosomia [6].

In a prospective observational study by Dietz et al, 61 nulliparous women underwent 3-dimensional translabial ultrasound at 36-40 weeks of gestation as well as 2-6 months postpartum. Fifty women (80%) were seen postpartum. Of the 39 women who delivered vaginally, levator avulsion was diagnosed in 14 (36%, 95% confidence interval 21-51%) [2]. In a retrospective study by Dietz et al, 1,112 women with a median parity of 2 were analyzed using 3D/4D translabial ultrasound and digital assessment. Levator avulsion was diagnosed whenever the examiner could not digitally palpate the

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origin of the pubococcygeal muscle on the inferior pubic ramus and/or whenever a discontinuity between bone and muscle was detected on ultrasound. Avulsion injuries were found in 252 women (23%) [11].

While there are no definitive explanations as to why the pubococcygeus is the most common muscle segment involved in obstetric-related levator injury, a study by Lien et al was designed specifically to try and answer this question. In this study, serial MRI images of a healthy nulliparous 34-year-old woman combined with published anatomic data and engineering graphics software were used to make a three-dimensional computer model of the pelvis. The model was used to quantify pelvic floor muscle stretch induced during the second stage of labor as a model fetal head passively engaged and stretched the iliococcygeus, pubococcygeus, and puborectalis muscles. In this study, the largest tissue strain (determined by measuring stretch ratio, i.e. tissue length under stretch/original tissue length) was in the medial pubococcygeus muscle (stretch ratio of 3.26). This is consistent with the documented levator injuries observed in postpartum females. The large stretch ratio and propensity to injury was postulated to have occurred as a result of the pubococcygeus' short initial length and its medialmost position relative to the other levator muscles. Although the puborectalis muscle has similar origin to the pubococcygeus, its longer initial length resulted in a relatively smaller maximal stretch. The smaller stretch in the iliococcygeal muscles was attributed to its more lateral and posterior origin (relative to the birth canal) [13].

While a relatively common finding in postpartum females, an extensive literature search yielded no results for cases of levator ani avulsion in males (PubMed search key words: "levator" + "ani" + "trauma" or "avulse" or "avulsion"). Additionally, in the obstetric literature, there were no indications that the levator ani avulsion injuries occurred concomitantly with an avulsion fracture of the pubic symphysis, as in our case. In a prospective study by Miller et al, which was designed specifically to assess the appearance of levator ani avulsions on MRI, 20 women were recruited after first vaginal delivery with increased risk of significant muscle trauma (i.e. long second stage, vacuum forceps or anal sphincter laceration). Post delivery and 6-month follow-up sequences of the levator ani muscles were obtained on multiplanar 3T MR sequences using a cardiac coil and 4 mm intervals. The study evaluated: 1) Signal intensity reflecting trauma related muscle edema by comparing levator ani muscles that undergo active stretching with adjacent obturator internus muscles that undergo passive compression to hip flexors. 2) Pattern of signal intensity, uniform signal throughout levator ani muscle or focal muscle subdivisions. 3) Muscle fiber partial or full tear. 4) Pubic bone marrow edema. Post delivery results demonstrated 1) All women initially had increased signal in the levators, no increase in obturators or hip flexors with return to normal signal at 6 months. 2) All increased signal was in the anterior portion of the muscle near the pubic origin and none in the posterior iliococcygeal portion. 3) No tears were present in 14, questionable tears in 3, and defined tears in 3 women after delivery with stable findings at 6 months in 9 imaged. 4) In 9 women with post delivery fluid sensitive sequences, 8 had pubic bone marrow edema and 1 had none [14]. In this focused study, however, there was no mention of levator ani avulsion with an associated avulsion fracture. We postulate that given the length of time over which the obstetric patient obtains her injury during labor (i.e. hours), the relatively slow process of avulsion allows the muscle to gradually tear at its insertion point on the pubis. This is in contrast to the equestrian patient who sustained his injury in a very short period of time (i.e. less than 1 second). Thus, when his levator ani muscle avulsed, it took a piece of the pubis with it.

Despite the differences in the length of time over which these injuries are incurred, we believe that the mode of injury in our case is similar to that proposed in the obstetric literature. The young equestrian had tremendous stress placed directly on his pelvis by the force of the horse on top of him combined with the counterforce of the ground beneath him. Just as you squeeze a tube of toothpaste and the paste is forced out by following the path of least resistance, we believe that when the horse and ground compressed the pelvis of this unfortunate man, the increased pressure on his pelvis caused the levator muscle to avulse, allowing a decrease in intra-pelvic pressure (Fig. 4). As demonstrated in the 3D model study above, given the pubococcygeus' short length and medial location relative to the other levator muscles, it would be the likely segment to fail under the tremendous stress. This, however, is just a postulation. Given the vast differences between male and female pelvic anatomy, a direct comparison is not possible.

In terms of complications related to levator ani injury in post-partum females, one of the most common

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and frequently cited is pelvic organ prolapse later in life [2-11]. As mentioned above, however, the male and female pelves vary greatly in form and function. Thus, as to the risk of complications in our patient, we cannot predict. Possible complications include rectal prolapse, urinary incontinence or chronic pain or numbness if nerve injury is involved. However, these postulations are beyond the scope of this report.

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