Case Report

Fatty-falciform ligament appendage torsion (F-FLAT): Diagnosis and management in a pediatric patient

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A B S T R A C T
Fatty-falciform ligament appendage torsion (F-FLAT) is a rare condition manifested by torsion of the extraperitoneal fat within the falciform ligament. It is similar to intraperitoneal focal fatty infarctions, including omental infarction and epiploic appendagitis. We report herein the first case of F-FLAT in a pediatric patient that failed conservative management. Ultrasound and CT scan facilitated prompt diagnosis of this rare finding and expedited a quick trial of conservative management. Despite conservative treatment, symptoms persisted for 4 weeks, but resolved after laparoscopic single-site surgical resection. In this report, we discuss the clinical features, key radiographic findings, and treatment options for this unique condition. This is only the third reported pediatric case of F-FLAT in the literature, and the first pediatric case to require surgical resection.

Clinical case
A 13-year-old girl presented to the emergency department with 3 days of epigastric abdominal pain. The pain localized to the mid-epigastrium and worsened with deep inspiration. The pain improved with abdominal flexion. On examination, her vital signs were within normal limits. Focal tenderness was elicited upon palpation of the epigastrium. Laboratory evaluation revealed a mild leukocytosis (14.2 × 10^9/L) (normal range 3.9-10.6 × 10^9/L). Basic metabolic and liver function tests were normal. Due to clinical concern for acute cholecystitis, a right upper quadrant ultrasound was performed.

In the region of the falciform ligament, between the left and right subphrenic spaces, ultrasound (US) demonstrated
Transverse US demonstrates an ill-defined echogenic fatty mass (circle), in region of the falciform ligament diving the medial and lateral segments of the left lobe of the liver (asterisks). GB = gallbladder. (b) Transverse US mid abdomen with color Doppler. Image demonstrates a hyperechoic mass (straight arrow) with no internal flow. GB = gallbladder.

Fig 1 – (a) Transverse US demonstrates an ill-defined echogenic fatty mass (circle), in region of the falciform ligament diving the medial and lateral segments of the left lobe of the liver (asterisks). GB = gallbladder. (b) Transverse US mid abdomen with color Doppler. Image demonstrates a hyperechoic mass (straight arrow) with no internal flow. GB = gallbladder.

an irregularly marginated echogenic mass, void of spectral Doppler flow (Figs. 1a, b), measuring 5 cm in maximum AP dimension. Diffuse hypoechochogenicity of the liver was also noted, suggesting an inflammatory process. A confirmatory CT scan of the abdomen/pelvis with IV and oral contrast revealed stranding of the peritoneal fat within the falciform ligament. The inferior extent of the fatty mass demonstrated a ‘hyperattenuating rim’ sign [1], an early sign of vascular occlusion. The vessels extending into the falciform ligament did not demonstrate contrast enhancement which substantiated concern for torsion of the fatty appendage of the falciform ligament (Fig. 2 a, b, c).

Surgical consultation was obtained, and conservative management was recommended via a trial of nonsteroidal anti-inflammatory medication for the presumed diagnosis of F-FLAT. Despite 4 weeks of observation, the patient’s pain persisted, and prevented her from returning to desired sporting activities. Ultrasound was repeated prior to surgery and demonstrated improved margination (Fig 3 a, b). Due

Fig. 2 – (a) Sagittal CT. Hyperattenuating rim sign and fatty mass with stranding extended into the liver along the course of the falciform ligament (arrows). (b) Coronal CT. (c) Axial CT. CT images of the abdomen and pelvis with IV and oral contrast. Coronal CT (b), and axial CT (c), demonstrate on oval fatty mass with a thin hyperdense rim along the course of the falciform ligament (circle). GB = gallbladder.
Fig 3 – (a, b) Two-week follow-up US imaging demonstrates decreased size and improved margination of mass indicative of decreased inflammation.

to persistent pain, the patient and her mother requested surgical excision.

A 2 cm incision was made through the umbilicus, through which a single-site laparoscopic port was introduced. A rubbery, fibrofatty soft tissue mass was identified in the falciform ligament, with extension into the round ligament of the liver (Fig. 4 a, b). The mass was resected with a laparoscopic bipolar electrosurgical instrument. Histology identified fat necrosis, vascular congestion, thrombosed vessels, and reactive mesothelial hyperplasia, suggestive of chronic inflammation. At a follow-up appointment, 2 weeks after the procedure, the patient’s pain had resolved.

Discussion

F-FLAT is a very rare anomaly and may be confused clinically with other causes of abdominal pain. Focal epigastric pain in pediatric patients is far more likely to be related to inflammatory conditions such as acute gastritis, cholecystitis, or pancreatitis. A high index of suspicion is required to make this diagnosis and prevent children from undergoing unnecessary interventions, which can be often be avoided in lieu of conservative treatment. We will briefly review the key points to consider in the evaluation of this diagnostic oddity.
of indeterminate nature and are commonly resected. However, if focal fatty infarctions are diagnosed radiographically, most will resolve with conservative treatment. Nonsteroidal anti-inflammatory drugs are the most commonly prescribed analgesics to control inflammation and pain, which usually resides within a week or 2 of diagnosis.

Diagnosing F-FLAT in a pediatric patient is very difficult for several reasons. Firstly, the diagnosis is extremely rare in children. To date, the radiographic diagnosis of F-FLAT has only been reported twice in the pediatric population. Macal- lum et al. reported a 10-year-old boy who presented with 5 days of right-sided abdominal pain, vomiting, diarrhea, and anorexia. Ultrasound reported no abnormalities, but the diagnosis of torsion of a lipomatous appendage of the falciform ligament was made on CT scan and treated conservatively with oral analgesia [6]. Nam et al. reported a 13-year-old boy with 3 days of right upper quadrant pain. The diagnosis of torsion of the lipomatous appendage of the falciform ligament was made with both ultrasound and CT scan findings. The patient was treated conservatively, and experienced complete resolution of symptoms. Follow-up ultrasound imaging demonstrated complete resolution of the previously seen torsed mass [7].

Currently, no reported cases of F-FLAT have been imaged with magnetic resonance imaging (MRI); all previous diagnoses have been made with ultrasound and CT. Ultrasound may be the initial diagnostic test of choice in pediatric patients with epigastric pain, given the lack of radiation exposure. Sonographic findings suggestive of F-FLAT include a hyperechoic, noncompressible, slightly heterogeneous mass in the area of the falciform ligament. On real-time sonography, the fatty appendage may not be affected by respiration, which is suggestive of an extraperitoneal structure [8,9]. The typical CT finding of F-FLAT is an area of increased fat density, within or adjacent to the falciform ligament. The fat density extends into the epigastric region and is associated with surrounding inflammatory changes [8,9].

As many cases of F-FLAT are known to resolve without surgery, a period of conservative management with rest and nonsteroidal anti-inflammatory medication is considered first-line treatment. Follow-up imaging with ultrasound, CT, or abdominal MRI may be considered if symptoms do not improve. Surgical resection of F-FLAT is generally reserved for cases in which pain persists and/or lifestyle is limited. The first identified case of F-FLAT requiring surgery was in an adult published by Webber et al. in 1977 wherein the torsion was an incidental finding during laparotomy of the patient with acute abdominal pain [10]. There is no consensus regarding the duration of nonoperative treatment prior to surgical intervention.

**Conclusion**

This report illustrates the pathophysiology, recommended diagnostic evaluation, and treatment of F-FLAT in the pediatric patient. The extreme rarity of F-FLAT mandates a radiographic evaluation, as the diagnosis has never been reported on clinical evaluation alone. Awareness of F-FLAT as a possible cause...
of abdominal pain in the pediatric patient is an essential precursor to making the radiographic diagnosis. When identified, surgical intervention can often be avoided. This is the first reported case of F-FLAT in a female pediatric patient that did not respond to conservative treatment, and ultimately was cured with minimally invasive surgical resection.

REFERENCES

[1] Indiran V, Dixit R, Madurai Muthu P. Unusual Cause of epigastric pain: intra-abdominal focal fat infarction involving appendage of falciform ligament - case report and review of literature. GE Port J Gastroenterol 2018;25(4):179–83 Epub 2017 Nov 15. doi:10.1159/000484528.

[2] Li XP, Xu DC, Tan HY, Li CL. Anatomical study on the morphology and blood supply of the falciform ligament and its clinical significance. Surg Radiol Anat 2004;26(2):106–9. doi:10.1007/s00276-003-0184-0.

[3] Varjavandi V, Lessin M, Kooros K. Omental infarction: risk factors in children. J Pediatr Surg 2003;38:233–5.

[4] Ayelet Rimon, Alan Daneman, J. Ted Gerstle, Savithiri Ratnapalan, J Pediatr. Omental infarction in children. 2009; 155(3): 427–431.e1. Published online 2009 Jun 21. doi:10.1016/j.jpeds.2009.03.039.

[5] Phalke N, Mehta Z, Das S. Utilization of imaging to identify a benign condition mimicking acute appendicitis in a child. J Investigig Med High Impact Case Rep. 2018;6:2324709618797989 Published 2018 Aug 31. doi:10.1177/2324709618797989.

[6] Macallum C, Eaton S, Chubb D, Franzis S. Torsion of fatty appendage of falciform ligament: acute abdomen in a child. Case Rep Radiol 2015;2015:293491. doi:10.1155/2015/293491.

[7] Nam JG, Choi SH, Kang BS, Kim JY, Kwon WJ. Serial ultrasound and computed tomography findings of torsion of lipomatous appendage of the falciform ligament in a child treated by conservative management. J Korean Soc Radiol 2015;72:368–71.

[8] Coulier B, Cloots V, Ramboux A. US and CT diagnosis of a twisted lipomatous appendage of the falciform ligament. Eur Radiol 2001;11:213–15.

[9] Coulier B. Contribution of US and CT for diagnosis of intraperitoneal focal fat infarction (IFFI): a pictorial review. JBR-BTR 2010;93:171–85.

[10] Webber CE, Gianges E, Crenshaw CA. Falciform ligament: a possible twist? Arch Surg 1977;112:1264.