Cesarean-Section Scar Endometrioma:
A Case Report and Review of the Literature

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ABSTRACT

Endometriomas can occur after any surgery where there is endometrial manipulation, and there are a number of reports of endometriomas developing in the abdominal wall at the site of the Pfannenstiel incision following Cesarean-section. Although this is ultimately a histopathologically-confirmed diagnosis, preoperative imaging including ultrasound, computed tomography, and magnetic resonance imaging may be helpful in the diagnosis and assessment. We report a pathology-confirmed case of Cesarean-section endometrioma with a classic, clinical presentation and imaging findings on computed tomography. A comprehensive literature review and discussion of the multi-modality imaging appearance of Cesarean-section endometrioma is also provided.

CASE REPORT

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Clinical History

The patient was a 37-year-old female presenting with left lower abdominal pain that had been occurring intermittently for the past 6 months. The patient described the pain as burning in nature and that it became worse during menses. Her surgical history was significant for three prior Cesarean sections, the last of which was approximately four years ago. On physical exam, there was a palpable knot located in the lower abdominal wall just lateral and superior to the left extent of the Pfannenstiel incision scar. The area of induration was approximately 2x2cm to palpation and was tender. The Pfannenstiel incision scar was well-approximated and well-healed without any evidence of erythema or drainage, and had no other appreciable masses around or underneath it. Past medical history was otherwise only notable for diabetes type II and obesity.

Imaging Findings

Routine helical computed tomography (CT) imaging of the abdomen and pelvis was performed with IV contrast. This demonstrated an oval hyperdense soft tissue mass in the subcutaneous fat of the left lower abdominal wall, measuring 3.2 x 2.8 cm (Figures 1 and 2). Of note, a noncontrast CT scan was obtained 6 months prior to assess for suspected ureterolithiasis. This prior study demonstrated a similar finding in the same location but it measured slightly smaller (2.5 x 2.3 cm) (Figures 3 and 4). At the time of the prior scan, the finding was favored to represent a hematoma (likely post-traumatic). However, given that this finding did not resolve and in fact became slightly larger over 6 months, and that the patient's symptoms included cyclical pain along with menses, the diagnosis of Cesarean section scar endometrioma was then favored.

Management

The patient was offered surgery to excise the suspected Cesarean scar endometrioma. The mass was surgically excised with clear margins and the patient tolerated the procedure without incident. Gross examination of the specimen showed the mass to measure approximately 3 cm in its entirety (Figure 5). Sectioning of the mass revealed a red-white, hemorrhagic, and mottled cut surface (Figure 6). Post-surgical digital

photograph shows the small incision that was made on the lateral superior aspect of the left side of the Pfannenstiel scar (Figure 7).

Histopathologic analysis of a hematoxylin and eosin photomicrograph of the mass demonstrated at 4X low power view the endometriotic nodule with adjacent adipose tissue (Figure 8a). A 10X view of endometrial glands and stroma was shown with associated blood and fibrin in the fibrous scar (Figure 8b). Also, a 40X close up view of the mass demonstrated endometrial glands with tubal metaplasia, sitting with adjacent endometrial stroma and blood (Figure 8c).

Follow-Up

The patient did not encounter any postoperative complications and was discharged the day of surgery. The patient reported no cyclical pain with menses following surgical excision and complete resolution of symptoms. No medications or hormonal treatments were administered following resection.

DISCUSSION

Introduction:

Endometriosis is defined as the ectopic presence of functional endometrial glands and stroma in any organ other than the uterus [1, 2]. It most commonly occurs in the pelvis, ovaries, pouch of Douglas, and uterine ligaments, however, it can theoretically occur following any procedure disturbing the endometrium of the uterus and can implant spontaneously or following uterine implementation [2]. An endometrioma can occur anywhere in the abdominal cavity and can even implant on abdominal wall scars, incisions following gynecologic procedures, and trocar entry points after laparoscopic surgery [3]. Due to the recent rise in Cesarean sections, there has been an increase in prevalence of abdominal wall endometriomas along with published case reports [4]. Interestingly, it has been demonstrated that Cesarean operation indication as well as surgical technique have not been contributing factors for the development of endometriomas, as the implanting risk for every Cesarean section is equal [4]. Therefore, other factors such as genetics, endocrine factors, or wound environment may be contributory.

Demographics:

The prevalence of Cesarean-section scar endometriomas is difficult to obtain, primarily due to its varying clinical presentation. While some patients experience the classic features of a palpable, painful nodule that has cyclical pain associated with menses, others may be completely asymptomatic with no clinical significance. The reported incidence of scar endometriosis following a Cesarean section ranges from 0.2-0.8% in the literature [5, 6]. This is a diagnosis essentially reserved for women of childbearing years following instrumentation of the uterus during a Cesarean section, and the mean age of women who are affected varies from 24-47 years with an average of 31.27 years [4].

Etiology:

There are several proposed pathophysiological theories for the etiology of endometriosis, the most commonly accepted being the implantation or reflux theory where endometrial tissue passes through the fallopian tubes and attaches at ectopic sites. The refluxed extra-uterine endometrial tissue can then be iatrogenically transplanted during gynecologic or obstetric procedures, especially during a Cesarean section. Some other proposed theories include the direct extension of ectopic endometrium through the uterine musculature and the coelomic metaplasia theory where endometriosis develops from metaplasia of cells lining the pelvic peritoneum [7].

The coelomic metaplasia theory provides a possible explanation as to why there are rare cases of men who are diagnosed with endometriosis [8, 9]. However, multiple other explanations such as endometriosis generated from the Müllerian-derived prostatic utricle and estrogen treatment for prostatic carcinoma confound speculations as to the definitive etiology [8].

Clinical Findings

Presenting symptoms usually include a painful, palpable abdominal mass, cyclical/non-cyclical pain, dysmenorrhea, a cyclically growing mass in or adjacent to the Cesarean incision scar, or an absence of symptoms at all. Patients can present with Cesarean-section endometriomas months to years following an obstetric/gynecologic procedure, with no correlation of birth related factors [2, 4, 10]. Patients may present to dermatologists, general surgeons, obstetricians, or gynecologists, therefore a variety of physicians should be familiar with the classic symptoms and presentation.

Although a Cesarean scar endometrioma is often located in subcutaneous tissue, it can possibly infiltrate into the abdominal rectus muscle as well as fascia, therefore, preoperative imaging is crucial for accurate surgical planning and material procurement. It is important to keep in mind that the appearance of the endometrioma at the time of imaging can depend upon the phase of the patient's menstrual cycle as well as the amount of bleeding and inflammation present [11].

Ultrasound Findings

With ultrasound, a scar endometrioma can appear as a fixed solid, cystic, polycystic, or mixed nodule, depending on the amount of glandular and stromal components, which is largely nonspecific [12]. One of the most common findings is an oval/round heterogeneous hypoechoic area in the abdominal incision within surrounding hyperechoic fat, as well as internal, hyperechoic areas and fibrotic changes [2, 13, 14]. At histologic analysis, the hyperechoic ring is consistent with edematous adipose tissue that has been filled with inflammatory cells [15, 16]. Ultimately, ultrasound can be helpful in identifying the total number of lesions present, however, it is largely limited by patient habitus as well as ultrasonographer skill [2, 4]. Ultrasound has limited accuracy in evaluating the lesion size and infiltration depth, as the delineation between the endometrioma and surrounding tissue is subtle [2, 4]. There may also be spiculated margins present that infiltrate into the surrounding tissue, confounding exact characterization of the endometrioma [17]. Ultrasound can be

used for an image-guided biopsy of the endometrioma and should be sufficient for preoperative diagnosis and comprehensive preoperative planning in most cases.

If the ultrasound examiner is using a lower-frequency transabdominal transducer, which is best for assessing pelvic organs, any abdominal wall findings may be missed. With a high enough suspicion of an abdominal wall endometrioma, the indication must include complete assessment of the abdominal wall as well, so that a high-resolution linear transducer can be used [18].

Because there is limited blood flow to the endometrioma, classic Doppler examination typically will not add any information to the ultrasound characteristics. Cesarean section endometriomas often have no blood flow or approximately 1-2 vessels, but there may be a vascular pedicle entering the mass [3, 19].

It has been demonstrated that the use of alpha-blend elastography may improve ultrasound assessment of an abdominal wall endometrioma from an overall accuracy of 33.3% up to 87.9% [19]. With the use of strain elastography, the tissue stiffness of hard tissues can be delineated from that of soft tissues, and better characterization of location and size can be achieved. Abdominal wall endometriomas were shown to be hard nodules that were more clearly defined from the surrounding soft tissue, and the addition of alpha-blend elastography gave a clearer picture of nodule size in addition to nullifying body mass index factors [19].

It has also been suggested that 3-dimensional ultrasonography may increase the specificity of ultrasonography as well as further characterize an endometrioma preoperatively. Using 3-dimensional ultrasonography, it can be shown that an endometriotic nodule has irregular and spiculated margins as well as infiltration into surrounding tissue [20]. The details regarding both the volume of the lesion as well as the degree of infiltration may assist in further preoperative planning.

CT Findings

CT findings of an abdominal wall endometrioma, although nonspecific, include a solid-appearing, soft-tissue mass in the region of the surgical scar that may demonstrate enhancement after administration of intravenous contrast. The mass will typically be hyperattenuating compared to surrounding muscle, however, the attenuation can vary [11]. Depending on the vascular supply to the endometrioma, it may contain blood products that produce varying levels of attenuation, making it heterogeneous in appearance. Because the ectopic tissue may be deposited in the rectus muscle, sheath, or subcutaneous tissue, there may be an enhancing rectus muscle mass or a solid, well-circumscribed subcutaneous mass present [21, 22]. Often, scar endometriosis may be incidentally noted in women undergoing CT scans for other purposes. CT imaging is most helpful in excluding alternative diagnoses in abdominal wall masses such as hernias, soft-tissue tumors, and abscesses [11]. PET/CT imaging typically does not reveal a FDG avid endometrioma, however, there have been case reports of FDG avid endometriomas in the literature [23]. Therefore, the

primary role of CT should mainly be for determining the extent and size of the disease as well as to rule out other causes of an abdominal wall mass [18].

MRI Findings

A magnetic resonance image (MRI), with its high soft tissue contrast, allows better delineation between the endometriotic lesions and surrounding tissue [21]. MR is helpful in differentiating between the glandular and fibrous components of the implanted endometrial tissue [18]. There will be hyperintense, heterogeneous signal intensity of the affected area, often with high internal punctate signal intensity on both T1 and T2 weighted images, indicative of hemorrhage from the endometrial glands [24]. On T2 weighted images, chronic scar endometriosis may have a low signal intensity of the lesion because of the fibrous component of the endometrioma [18]. The chronic blood component (hemosiderin) will be T1/T2 hypointense while T2* GRE will demonstrate hemosiderin deposition with susceptibility artifact. MRI is considered the superior imaging modality to fully characterize an endometriotic lesion, rule out other differential diagnoses, as well as to aid in preoperative planning.

Diagnosis & Treatment:

Although preoperative diagnosis is largely dependent on imaging characteristics, tissue diagnosis may be considered in some cases. However, needle tract endometriosis after a procedure such as amniocentesis has been reported, therefore, including the site of aspiration or biopsy tract during surgical resection is advisable [25]. Ideally, the most reliable method of diagnosis is an excisional biopsy [3].

Wide excision with at least 1 cm margins is considered the treatment of choice for Cesarean-section and scar endometriomas in order to prevent recurrence as well as to avoid possible malignant transformation [3, 4, 25]. Depending on the amount that needs resected as well as the depth of invasion, patients may require skin flap transplantation or mesh to cover the fascial defect. Recurrence is likely if there is incomplete surgical excision or rupture, and careful manipulation is required during any surgery that exposes endometrial tissue [10]. After surgical resection, the patient may also be treated with hormonal-based therapies such as GnRHa, gestrinone, or oral contraceptives to help provide symptomatic relief and reduce recurrence [4]. Most cases have significant, if not complete, symptomatic relief following surgical resection, however, recurrence is possible. If there is continual recurrence following excision, malignancy should be ruled out, as up to approximately 1% of endometriomas could possibly undergo malignant transformation typically to endometrioid or clear cell carcinoma [26].

Final diagnosis requires pathologic analysis of the excised specimen. Confirmation of endometrioma is reached if two out of the three following features are present: spindled endometrial stroma, endometrial-like glands, or hemosiderin pigment either within macrophages or in the stroma [22, 27]. Histopathological exam demonstrates a mixture of variably sized glandular structures that are capable of undergoing

cyclical variation. Epithelial cells lining the glands can range from cuboidal to columnar with relatively normal cytomorphology and are surrounded by a mucinous and edematous stroma [28].

Differential Diagnoses:

The clinical presentation of a Cesarean section endometrioma can mimic many different diagnoses, however, the most important diagnostic information includes a history of a Cesarean section, specific imaging findings, as well as the potentially cyclical nature of symptoms. Differential diagnoses that should be considered in the diagnostic workup of an abdominal wall pathology, especially in the context of a female status post cesarean-section, should include hematoma, an injection site or injection granuloma, desmoid tumor, keloid scar, suture granuloma, and incisional hernia.

Hematoma

A hematoma is a commonly encountered acute to subacute complication following a Cesarean section or could be due to subsequent trauma [29]. The patient will present with incision pain and the mass would be expected to evolve or resolve over time. Physical exam would be significant for tenderness to palpation without any cyclical variation, as well as lack of induration in the acute phase. Rectus sheath hematomas as well as subfascial hematomas are due to disruptions of the inferior epigastric vessels during a Cesarean section [30, 31]. Rectus sheath hematomas can be found in the superficial anterior abdominal incision area and will be located anterior to the rectus muscle [32]. Diagnosis is based off of imaging findings as well as clinical presentation after Cesarean section. Ultrasound findings are often nonspecific, consisting of anechoic to hypoechoic cystic areas or complex collections, while a CT can demonstrate more superficial findings with better localization anterior to the rectus muscle [32]. Serial ultrasound examinations should demonstrate either evolution or reduction in size with variable amounts of internal heterogeneous echogenicity dependent on the degree of blood coagulation. There will be a well circumscribed, hyperdense mass demonstrated on CT during the acute phase that may show active contrast extravasation with enhanced CT that will become more isodense in the subacute phase. MRI appearance of the hematoma will largely depend on the stage of the hemorrhage [33]. In the acute phase, the hematoma will be isointense on T1W1 but variably hyper- to hypointense on T2W1, while in the subacute phase, the hematoma will appear hyperintense on T1W1 and T2W1 but the hemosiderin will be T1/T2 hypointense. In addition, abdominal wall hematomas can often result in a fall in hemoglobin as well as fever, which was also not encountered in our patient. Because our patient had only a remote history of a Cesarean section and no history of recent trauma, this diagnosis was excluded.

Injection Sites/Granulomas

Injection sites or injection granulomas can be identified in typical locations such as the buttocks or the anterior abdominal wall in the patient with a known history of medication injections such as heparin or insulin. There may be tender induration on physical exam similar to an endometrioma, however, there may also be superficial erythema. On ultrasound, there will be a nonspecific, anechoic, cystic-appearing mass with variable echogenic areas during the acute phase with no internal flow on Doppler imaging. Chronically, ultrasound may show either the reduction of the area over time, or the appearance of an injection granuloma that will appear more solid with variable calcifications. With CT imaging, the acute injection site will be a heterogeneous, hyperdense, rounded mass that can become a soft tissue, hyperdense mass with variable calcifications in the subacute or chronic phase. MRI will reveal an ill-defined T2 hyperintense area in the abdominal wall in the acute phase, while the subacute/chronic phase might show a T2 hyperintense or hypointense mass depending on whether the granuloma is a result of inflammatory or fibrous reaction.

Abdominal Wall Desmoid Tumor

Abdominal wall desmoid tumors are rare, benign neoplasms that can arise from the muscle aponeurosis and are associated with pregnancy, trauma, and familial adenomatous polyposis [34]. Desmoid tumors can present as gradually increasing palpable masses, however, they typically do not have cyclical pain, which can be helpful in distinguishing them from scar endometriosis [11]. Ultrasound features of superficial desmoid tumors are very similar to C-section endometriomas revealing lobulated, hypoechoic masses with heterogeneous internal echoes [35]. On contrast-enhanced CT scans, the tumor can have a well-defined margin and high attenuation relative to the surrounding muscle [36]. With MRI, clear borders of the tumor can often be delineated along with heterogeneous hyperintensity on T2 imaging and relative hypointensity to muscle on T1 imaging [36, 37]. Desmoid tumors are also typically hypoenhancing on the post-contrast imaging. CT and MR imaging are typically more useful imaging modalities, as these tumors are not always superficial enough to be assessed thoroughly with ultrasound. In addition, these tumors can grow large enough to produce a mass effect on surrounding organs, which can be seen more easily on cross sectional imaging. Ultimately, histopathologic examination revealing a benign proliferation of well-differentiated fibroblasts will be necessary in diagnosing a desmoid tumor over an endometrioma [38].

Keloid Scar

Both keloid scars and suture granulomas can be difficult to characterize with imaging alone and may require biopsy in order to fully characterize them [11]. However, a keloid's unique appearance on physical examination can be diagnostic of the condition, as there will be fibroproliferative growth beyond the original wound edges, bosselated lumps, and infiltration and invasion into adjacent tissues [39]. Keloids are hypercellular soft tissue masses predominantly composed of type 1 collagen that appear hypoechoic on ultrasound with variable heterogeneity depending on myxoid degeneration present. There are no distinguishing features on CT imaging of a keloid, however, on PET/CT, there may be some hypermetabolic areas due to hyperplasia and cell turnover. The short T2 relaxation time on MR imaging of a keloid can be accounted for by the abundant collagen, and the T1/T2 rounded or linear low-intensity foci are attributable to the low cellularity, collagen content, and resultant reduced proton mobility.

Suture Granuloma

At ultrasound, a suture granuloma can appear as a well-defined, hypoechoic mass with either single or double hyperechoic lines within, representing the retained suture. On CT imaging, a heterogeneous, hyperdense, abdominal mass with minimal vascularization can be identified [40, 41]. There may be a focal, linear, hyperdense suture if present, and the chronic phase may show calcifications. PET/CT may show hypermetabolic areas mimicking neoplasm. A suture granuloma will have a variable appearance on MRI with areas of heterogeneous T1/T2 signal.

Incisional Hernia

Incisional hernia is a clinical consideration that should ultimately be assessed with cross-sectional imaging [11]. In patients who present with a palpable swelling or cough impulse, ultrasound is a valuable initial imaging tool and allows the advantage of observing the mass during both rest and the Valsalva maneuver. Ultrasound should always be performed on a soft tissue mass in the abdominal wall before obtaining a biopsy. During an ultrasound examination, a fascial defect in the anterior abdominal wall should be detected as well as hypoechoic bowel with hyperechoic mucosa and/or adipose tissue contained in the herniated sac [42]. A fascial defect might be detected in the abdominal wall on both CT and MR with bowel and/or fat extending through that demonstrates continuity with the intra-abdominal bowel. On noncontrast CT, the fluid-containing bowel lumen as well as the fat will be hypodense. With MR imaging, the fluid-containing bowel lumen will be T1 hypointense and T2 hyperintense, while fat will be T1/T2 hyperintense.

TEACHING POINT

A Cesarean section scar endometrioma should be considered high in the differential diagnosis for any solid-appearing mass seen in the expected region of the Pfannenstiel scar which presents with cyclical pain corresponding with menses.

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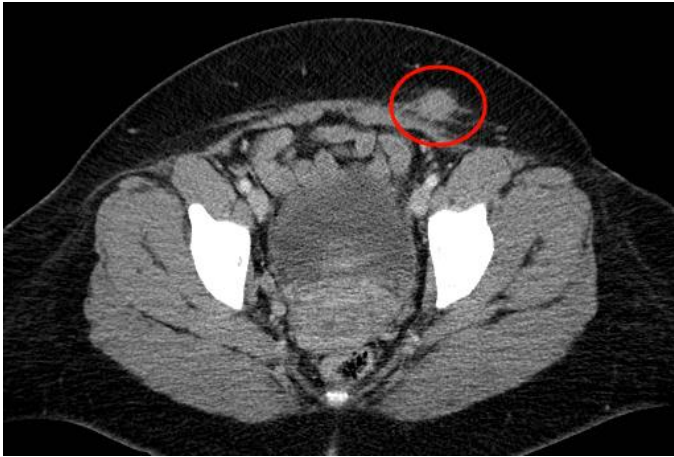
FIGURES

Figure 1 (top): 37-year-old female with cyclical left lower abdominal pain and a palpable mass at the left extent of the Pfannenstiel incision scar, consistent with an endometrioma.

FINDINGS: Axial CT image of the abdomen at presentation following the administration of IV contrast. Red oval demonstrates the site of the 3.2 x 2.8 cm subcutaneous soft tissue density present in the Cesarean-section scar in the anterior abdominal wall.

TECHNIQUE: Axial CT images obtained with intravenous contrast administered (94 cc of Omnipaque) and no oral contrast. Scanner was Siemens Somatom Sensation 64 slice, settings were 140 kV and 359 mA, Pitch 0.8, FOV 42.5 cm, with 5 mm slices displayed. 2.0 mm coronal reformatted images were also produced.

Figure 2 (top right): 37-year-old female with cyclical left lower abdominal pain and a palpable mass at the left extent of the Pfannenstiel incision scar, consistent with an endometrioma.

FINDINGS: Coronal CT image of the abdomen and pelvis at presentation following the administration of IV contrast. A 3.2 x 2.8 cm subcutaneous soft tissue density was noted in the left lower anterior abdominal wall (arrow).

TECHNIQUE: Coronal CT reconstructions with intravenous contrast administered (94 cc of Omnipaque) and no oral contrast. Scanner was Siemens Somatom Sensation 64 slice, settings were 140 kV and 359 mA, Pitch 0.8, FOV 42.5 cm. 2.0 coronal reformatted images displayed.
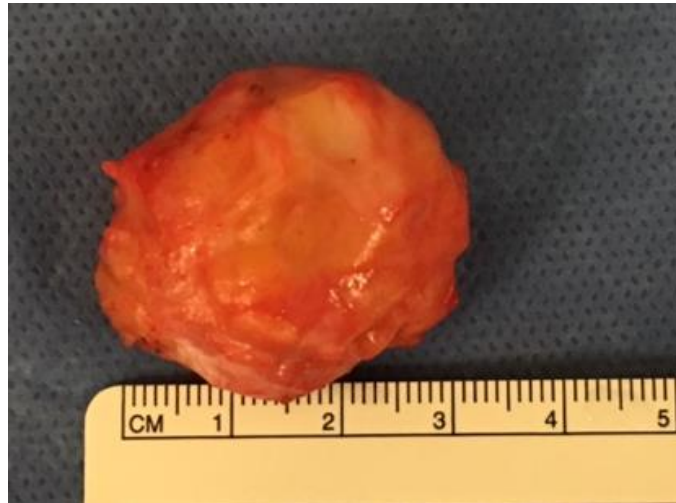
Figure 3 (middle right): 37-year-old female with a Cesarean-section scar endometrioma who presented 6 months prior with vague abdominal pain and imaged due to concern for ureterolithiasis.

FINDINGS: Axial CT image of the abdomen following the administration of IV contrast. A 2.5 x 2.3 cm subcutaneous mass was noted (red oval).

TECHNIQUE: Axial CT images obtained without intravenous contrast or oral contrast. Scanner was Siemens Somatom Sensation 64 slice, settings were 140 kV and 359 mA, Pitch 0.8, FOV 42.5 cm, with 5 mm slices displayed. 2.0 mm coronal reformatted images were also produced.
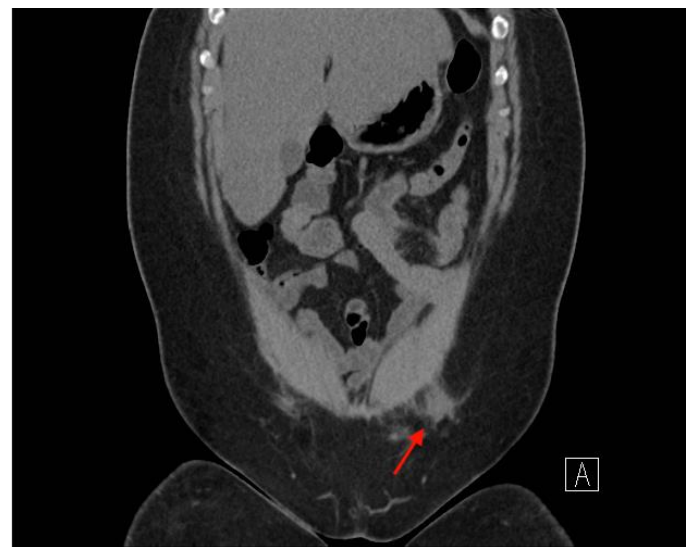
Figure 4: 37-year-old female with a Cesarean-section scar endometrioma who presented 6 months prior with vague abdominal pain and imaged due to concern for ureterolithiasis.

FINDINGS: Coronal CT image of the abdomen and pelvis without IV contrast performed 6 months prior to the described presentation for suspected ureterolithiasis. A 2.5 x 2.3 cm soft tissue bruise or hematoma was incidentally noted with no clinical correlation at the time (red arrow).

TECHNIQUE: Coronal CT reconstructions without intravenous contrast or oral contrast. Scanner was Siemens Somatom Sensation 64 slice, settings were 140 kV and 359 mA, Pitch 0.8, FOV 42.5 cm. 2.0 coronal reformatted images displayed.

Figure 7: Post-operative digital photograph of a 37-year-old female with a Cesarean-section scar endometrioma following closure of anterior abdominal wall after complete excision of the endometroid nodule. The incision was made on the lateral and superior left extent of the Pfannenstiel incision scar.

Figure 5: Gross specimen of the resected endometrioma nodule from a 37-year-old female recovered after surgical excision. The nodule measured approximately 3 cm in diameter.
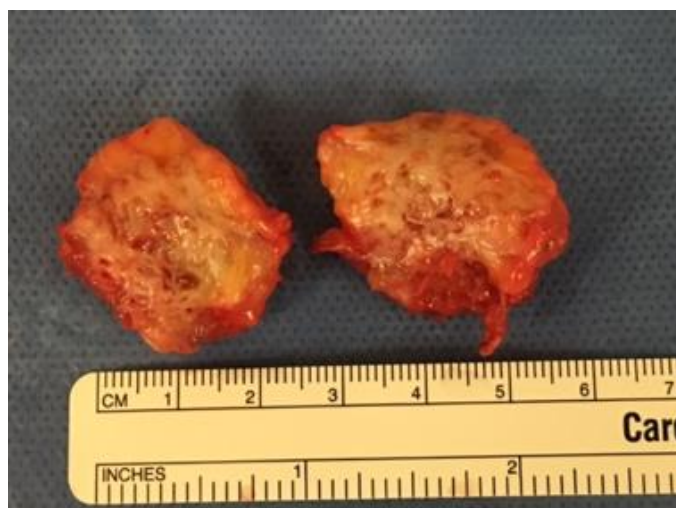
Figure 6: Resected endometrioma nodule from a 37-year-old female. There are two un-oriented and disrupted pieces of yellow-brown, cauterized tissue measuring 2.9 x 2.2 x 1.2 cm and 3.3 x 2.4 x 1.4 cm. The surfaces are inked black. Sectioning revealed a red-white, hemorrhagic and mottled cut surface.
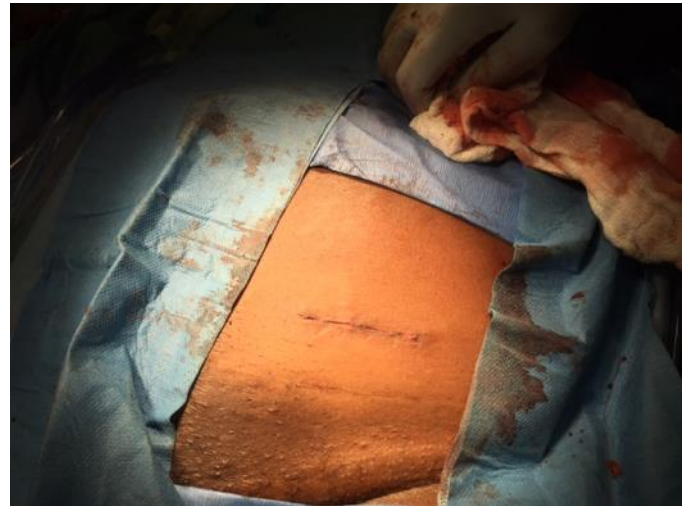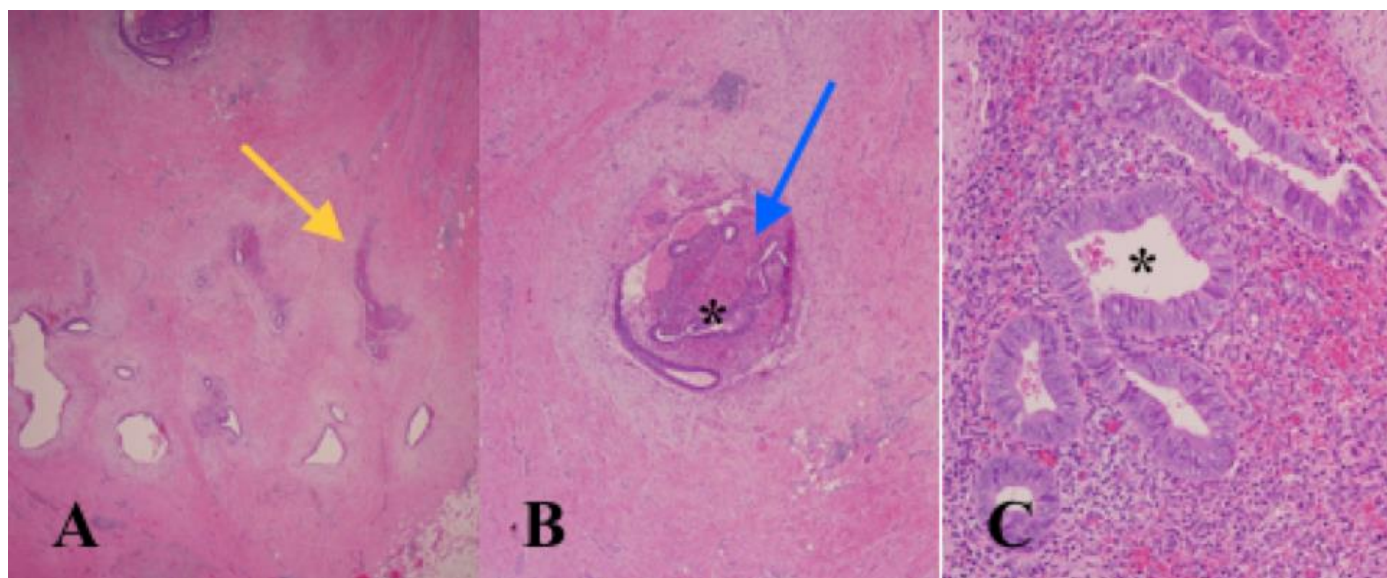
Figure 8: 37-year-old female with cyclical left lower abdominal pain and a palpable mass at the left extent of the Pfannenstiel incision scar, consistent with an endometrioma.

FINDINGS: Hematoxylin and eosin-stained photomicrographs (a) 4X low power view of the scar with endometriosis (yellow arrow) and adjacent adipose tissue; (b) 10X view of endometriosis comprised of endometrial glands (denoted by *) and stroma (surrounding purple area denoted by a blue arrow) with associated blood and fibrin in fibrous scar; (c) 40x close up view of the endometrial glands with tubal metaplasia (denoted by *), sitting with adjacent endometrial stroma and blood.

Etiology	There are several proposed mechanisms of endometriosis, the most commonly accepted being the implantation or reflux theory. With the passage of endometrial tissue through the fallopian tubes, it can then be spontaneously or iatrogenically transplanted to other sites where proliferation and growth can occur. Another theory that has been proposed is the coelomic metaplasia theory where the endometriosis develops from metaplasia of cells lining the pelvic peritoneum. This theory potentially explains why there have been limited cases of endometriosis diagnoses in men.
Incidence and prevalence	Difficult to obtain due to varying clinical presentation. According to the literature, scar endometriosis following a Cesarean section ranges from 0.2-0.8%.
Gender Predilection	The diagnosis of Cesarean section endometrioma is reserved exclusively for women who have previously undergone Cesarean sections for prior pregnancies.
Age Predilection	Typically, in women of childbearing age. Ranges in age from 21-47 with a mean age of around 32 years.
Risk Factors	Unknown. Several studies have shown that cesarean operation indication as well as surgical technique have not been contributing factors for the development of endometriomas, as the implanting risk for every cesarean section is equal. Therefore, outside factors such as genetics, endocrine factors, wound environment, etcetera may be more influential contributory causes.
Treatment	Complete surgical excision is the treatment of choice for symptomatic patients. Hormonal therapy may or may not also be offered for symptomatic treatment.
Prognosis	Complete surgical excision typically results in complete resolution of symptoms. In older patients, endometrioma recurrence could be indicative of malignant transformation in about 1% of cases.
Imaging Findings	On ultrasound, a Cesarean scar endometrioma can appear as an oval/round heterogeneous hypoechoic area in the abdominal incision within surrounding hyperechoic fat, along with internal hyperechoic areas and fibrotic changes. There may also be spiculated margins present that infiltrate into the surrounding tissue. Typically have no internal Doppler flow. On CT, there may be a slight, hyperattenuating rectus abdominis mass or a solid, well-circumscribed subcutaneous mass present, although these findings are nonspecific. CT is most helpful in excluding alternative diagnoses and determining the extent of the abdominal wall mass. On MRI, there is a solid-appearing, sometimes spiculated subcutaneous mass usually without enhancement; usually hyperintense on T1WI and variable intensity on T2WI, but may see areas of T2 shading. Areas of T1/T2 hyperintensity will remain hyperintense on FS sequences.

Table 1: Summary table for Cesarean-section endometrioma.

Differential	Clinical Presentation	US Findings	CT Findings	MRI Findings
Hematoma	• Incision pain • History of C-section or trauma • Mass would be expected to decrease in size or evolve over time	• Acute: anechoic, cystic-appearing mass with echogenic areas; surrounding soft tissue edema; no internal flow on Doppler imaging • Subacute/chronic: evolves in size; may have well-defined margins; heterogeneous echogenicity depends on degree of blood coagulation; maybe mild peripheral hyperemia on Doppler	• Hyperdense mass in acutely that becomes isodense to muscle later • Surrounding fat stranding • Active contrast extravasation on enhanced CT in acute phase • Mass is expected to evolve or decrease over time	• Acute: isointense on T1WI; variable hyper- to hypointense on T2WI. • Subacute/chronic: hyperintense on T1WI and T2WI but hemosiderin is T1/T2 hypointense; T2* GRE: Hemosiderin deposition with susceptibility blooming artifact
Injection site/ injection granuloma	• Known history of medication injections such as heparin or insulin • Typical location such as buttocks or anterior abdominal wall	• Acute: nonspecific ultrasound appearance; anechoic cystic-appearing mass with some echogenic areas; no internal flow on Doppler • Subacute/chronic: evolves in size over time, or may become granuloma: more solid-appearing mass +/- shadowing calcifications	• Acute: heterogeneous hyperdense rounded mass • Subacute/chronic: evolve over time, or may become injection granuloma; soft tissue hyperdense mass +/- calcifications	• Acute: ill-defined T2 hyperintense abdominal wall focus; may be T1 hypointense • Subacute/chronic: evolve over time or may become injection granuloma; T2 hyperintense or T2 hypointense depending on whether inflammatory or fibrous reaction, respectively; T1 hypointense
Desmoid tumor	• Gradually increasing palpable mass without cyclical pain • Often arise from rectus or oblique muscles, particularly at incision site • Risk factors: prior surgery, trauma, Gardner syndrome, familial adenomatous polyposis	• Lobulated hypoechoic mass • Heterogeneous internal echoes	• Lobulated mass with well-defined margin and high attenuation relative to the surrounding muscle	• Defined borders with heterogeneous hyperintensity on T2 imaging • Relative hypointensity to muscle on T1 imaging • Typically, are hypoenhancing on the post-contrast imaging
Keloid	• Fibroproliferative disorder • Extension beyond the original wound edges and invading adjacent tissues	• No clear imaging features to distinguish from other soft tissue masses • Generally, tend to be hypoechoic; may have some heterogeneity	• No clear CT imaging features to distinguish from other soft tissue masses • PET/CT may be hypermetabolic due to hyperplasia/ turnover	• May have heterogeneous T1/T2 hypointensity • Rounded or linear low-intensity foci on both T1 and T2-weighted images
Suture granuloma	• Mass-like lesion that ranges from asymptomatic to vague pain or discomfort	• Well-defined, hypoechoic mass with hyperechoic single/double lines found within representing the suture	• Heterogeneous hyperdense mass, may see focal linear hyperdense suture if present • Chronic stage may contain calcifications • May be hypermetabolic	• Variable appearance on MRI, with areas of heterogeneous T1/T2 signal
Incisional hernia	• Focal abdominal swelling • Enlarge with Valsalva maneuver or coughing • Painful if strangulated	• Fascial defect in abdominal wall • Hypoechoic bowel with hyperechoic mucosa and/or adipose tissue in herniated sac	• Fascial defect in abdominal wall with hypoattenuating bowel and/or fat	• Fascial defect in the abdominal wall with bowel and/or fat extending through • Fluid-filled bowel lumen will be T1 hypointense and T2 hyperintense • Fat will be T1/T2 hyperintense, T1FS/T2FS hypointense
Cesarean-section endometrioma	• Solid-appearing mass seen in the expected region of the Pfannenstiel scar which presents with cyclical pain corresponding to menses	• Oval/round heterogeneous hypoechoic area • Surrounding hyperechoic fat • Internal hyperechoic areas and fibrotic changes • May have spiculated margins • No internal Doppler flow	• Hyperattenuating rectus abdominis or mass or a solid, well-circumscribed subcutaneous mass • CT can help determine the extent of the mass • PET/CT imaging is not typically FDG avid	• Solid-appearing, spiculated, subcutaneous mass • Typically, no enhancement • Hyperintense on T1W1 and variable intensity on T2W1, but may have areas of T2 shading • T1/T2 hyperintensity will remain hyperintense on FS sequences • Chronic blood component (hemosiderin) is T1/T2 hypointense; T2*GRE: Hemosiderin deposition with susceptibility blooming artifact

Table 2: Differential diagnosis table for Cesarean-section endometrioma.

ABBREVIATIONS

CT = computed tomography
MR = magnetic resonance
MRI = magnetic resonance imaging

KEYWORDS

Cesarean section endometrioma; Cesarean scar endometriosis; scar endometriosis; incisional endometriosis; cutaneous endometriosis; endometriosis; endometrioma; abdominal wall

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