CT features of sclerosing encapsulating peritonitis
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Patient: 33 years, female

Clinical History:
A 33-year-old female patient with chronic renal failure, who was on continuous ambulatory peritoneal dialysis presented with a progressive lower abdominal pain and mild fever. Her plain abdominal X-ray images showed scattered calcifications in both iliac fossae that had been progressively increasing over the past four years. A native computed tomography of the abdomen when performed showed curvilinear calcifications delineating the peritoneum.

Imaging Findings:
A 33-year-old female patient with a chronic renal failure due to reflux nephropathy, was treated using CAPD during 1992–1995. In 1995, she had a renal graft that was soon rejected, and she was therefore put back on peritoneal dialysis in 1996. In November 2002, she presented with a vague progressive lower abdominal pain. There was no change in her bowel habit. A clinical examination that was done was found to be unremarkable apart from a mild fever of 38 ºC. The plain abdominal X-ray scan showed diffuse calcifications especially in both iliac fossae (Fig. 1b). When we compared this with previous X-ray scans taken in 1998 and 2000 (Fig. 1a), we noted that these calcifications were already present, but were less evident as some were scattered and progressed slowly over time. The native computed tomography images of the abdomen showed fine curvilinear calcifications delineating the visceral layer of peritoneum in the form of egg-shell-shaped calcifications and surrounding intestinal loops. A mild bowel wall thickening was also noted. Neither luminal dilatation nor intestinal obstruction was seen (Fig. 2). Since radiological features led to the diagnosis of sclerosing encapsulating peritonitis (SEP), it was suggested that peritoneal dialysis be stopped and the peritoneal catheter removed. The surgical removal of the catheter and an exploration of the peritoneum revealed thick, stiff, greenish brown bowel loops. A histopathological examination after doing a peritoneal biopsy showed a thickened fibrotic submesothelial basement membrane of about 2.000–3.000 mm. The mesothelial layer was largely abraded (Fig. 3a). Most of the vessels presented an important stenosing endofibrosis. Some of them were completely obstructed with microcalcifications (Fig. 3b). Few lymphocytic infiltrates around small arteries showed a chronic component of inflammatory reaction. No other inflammatory cells were observed. The final diagnosis made was that of sclerosing encapsulating peritonitis (SEP).

Discussion:
Sclerosing encapsulating peritonitis (SEP) is often interpreted as an unfavorable evolution of simple peritoneal sclerosis (SPS) induced by a series of negative factors (1, 8). The main etiopathological factor in peritoneal sclerosis is long term continuous ambulatory peritoneal dialysis (CAPD) as a result of the poor biocompatibility of peritoneal dialysis fluid (3). However, SEP also occurs in other conditions that are not related to CAPD, such as abdominal operations, multiple episodes of peritonitis, ventriculo-peritoneal shunts, systemic lupus erythematosus, abdominal tumors and drugs, for example, beta blockers which inhibit surfactant production (3). Although the exact pathogenesis of SEP is still uncertain, according to Dobbie et al. (3), fibrin exuding from the peritoneal membrane
should continuously be cleared by the peritoneal fibrinolytic activity. Anything disturbing the balance between exudation and removal in favor of exudation, will lead to the formation of fibrin bridges between opposed bowel surfaces followed by neovascularization and fibrinogenesis (3, 4). The few and damaged mesothelial cells present can then no more produce a sufficient amount of plasminogen activator to remove the fibrin which primes peritoneal fibrosis (3, 5). The overall prevalence of SEP compared to all cases of peritoneal sclerosis is 0.7% according to an Australian survey. A European survey found a prevalence of peritoneal sclerosis in 1.5/1000 patients at risk; 43% of them had SEP (3). A prevalence of SEP as high as 8% has been reported in patients with systemic lupus erythematosus (3). Histopathologically, the peritoneal alterations of SPS include desquamation of the mesothelial cells which detach from the basement membrane (1, 10, 11). After a rolonged dialysis is performed, the mesothelial basement membrane thickens and tends to duplicate. The basement membrane of the blood vessels also thickens and duplicates several times resembling the basement membrane observed in diabetic microangiopathy. The thickness of the sclerotic tissue in simple peritoneal sclerosis (SPS) does not exceed 40–50 mm (1, 10, 11). In SEP, unlike SPS, a dramatic progression of sclerosis occurs occurs and the thickness of the submesothelial sclerotic tissue reaches 2000–3000 mm, as demonstrated in our case. SEP is characterized by chronic inflammation, calcification and vascular alterations (1, 3, 12, 13), typically shown in our patient (Fig. 3). Macroscopically, the peritoneal surface is reduced to a rough, thickened membrane similar to the sole of a shoe (1), eventually followed by a parietal thickening of the intestinal loops which become progressively fixed and immobile (1, 2, 10, 11). Microscopically, the mesothelium is absent in SEP and is replaced by sclerotic tissue (1, 2, 10–12). In the matrix have been found fibroblasts, mesoblasts, leukocytes, erythrocytes, macrophages and giant cells which indicate a chronic inflammation (1, 2, 10, 11). Small abscesses complicate 0.7% of cases of SEP (1, 13). Peritoneal calcifications which are not characteristics of SPS, as they are in SEP (1, 2, 10–12), were also the characteristic findings in our case. Ossification of the peritoneum has occasionally been observed (1). Patients with SEP usually present with an abdominal pain, abdominal distension, nausea and vomiting. These symptoms usually occur in an insidious, chronic way, therefore, they are not always taken in to consideration at the beginning. Our patient presented with a mild diffuse abdominal pain which slowly progressed over three months. Abdominal X-ray images that were obtained showed calcified plaques or egg-shell calcifications and dilated intestinal loops were sometimes observed (3, 14). An ultrasound investigation demonstrates increased thickness of the peritoneal membrane with a characteristic trilaminar appearance (3, 15), as well as the presence of a free fluid. Native CT shows the most characteristic findings of SEP which are typically calcifications delineating the peritoneal surface. A CT scan also shows the precise localization of the peritoneal thickening and consecutive intestinal involvement. The bowel loops can be incorporated into a cocoon-like fibrous mass which is a pathognomonic finding (3). A CT therefore provides exact details of the risk of intestinal obstruction. In our case, the progressive formation of scattered calcifications, detected on plain abdominal X-ray scans and then becoming rather linear, led to the diagnosis of SEP in the context of CAPD, and this way later confirmed by doing a native CT which showed curvilinear calcifications exactly covering the visceral peritoneal surface. Finally, regarding the treatment of SEP, most of the publications suggest suspension of CAPD and removal of the peritoneal catheter. However, some claim that this may worsen the condition since the peritoneal fluid separates the intestinal loops and prevents adhesions (3, 16). Garosi and Di Paolo et al. have suggested treatment by intra-peritoneal administration of antibiotics before removal of the peritoneal catheter followed by steroids administration and chemotherapy (3, 17).

**Differential Diagnosis List:** Sclerosing encapsulating peritonitis.

**Final Diagnosis:** Sclerosing encapsulating peritonitis.

**References:**

Morphological aspects of peritoneal sclerosis.  
Peritoneal sclerosis--an overview.
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Structural and ultrastructural peritoneal membrane changes and permeability alterations during continuous ambulatory peritoneal dialysis.
Figure 1

Description: A plain abdominal X-ray image taken in 1996 showing diffuse abdominal calcifications in the right iliac fossa. Origin:
**Description:** A plain abdominal X-ray image taken in 2000 showing diffuse abdominal calcifications, located especially in the right iliac fossa. **Origin:**
Description: An axial native CT image demonstrating diffuse curvilinear calcifications delineating the intestinal wall as well as the catheter used for the peritoneal dialysis. Origin:
Description: A coronal reconstruction native CT image demonstrating diffuse curvilinear calcifications delineating the intestinal wall as well as the catheter used for the peritoneal dialysis. Origin:
Figure 3

a

Description: A thickening of the peritoneal layer by a large sclerosing fibrosis. No mesothelial cells are visualized on the peritoneal surface. Origin:

b

Description: Microcalcifications with endofibrosis seen within an arteriolar wall. Origin: