This paper reviews the issues associated with the reproductive system in the special population of female patients with end-stage renal disease on peritoneal dialysis (PD). We summarize current knowledge concerning cancer screening tests, elective and urgent gynecologic procedures, and the issues of menstruation, contraception, pregnancy, and delivery in these patients. Finally, we present the potential effects of gynecologic problems on PD and the complications of PD that can present with symptoms of the female genitalia.

Key words
Cyclic hemoperitoneum, cancer screening tests, pregnancy, gynecologic disease

Introduction
Women comprise a significant portion of the peritoneal dialysis (PD) population. This paper reviews the special characteristics of common gynecologic issues in those women, including menstruation, female-specific cancer screening tests (Pap smears and mammograms), contraception, pregnancy, and the impact of gynecologic disease on PD therapy.

Discussion
Menstruation
A considerable number of women of reproductive age with end-stage renal disease will continue to menstruate while on PD or will resume menses after a period of uremia-associated amenorrhea. The implications of these menstrual cycles for fertility are unclear, but conception should be assumed to be a possibility.

Menstrual bleeding can be a potential source of significant blood loss in PD patients and may be responsible for iron deficiency and consequent “resistance” to erythropoietin treatment. Menstrual flow has been reported to be heavier and to contain clots in dialysis patients. This heavy menstrual flow may become a particular problem in women on warfarin therapy. In complicated cases, the need for suppressive hormonal therapy to stop or reduce menstruation may be considered. In addition, tranexamic acid (Cyklokapron: Pfizer, New York, NY, USA), an antifibrinolytic agent, can be used to reduce the amount of menstrual blood loss in selected cases (1).

Cyclic hemoperitoneum
A clinical finding associated with menstrual bleeding is hemoperitoneum. Its presentation can vary from minor bloody contamination of the dialysate effluent, giving it a light red discoloration, to the appearance of gross blood in the effluent bag, which can be upsetting (Figure 1). These signs can be accompanied by diffuse abdominal tenderness, attributed to a mild chemical peritonitis resulting from exposure of the peritoneum to blood. However, as frightening as this bloody effluent might be for the patient, the blood loss is usually not as severe as it looks.
The causes of hemoperitoneum in PD patients can be divided into “benign” and “serious.” Among the benign causes, those associated with the female reproductive system account for most of the cases (Table I). They include menstruation, ovulation, or bleeding associated with the rupture of ovarian cysts. Serious causes can include bleeding associated with benign or malignant disease of intraperitoneal organs (such as liver, spleen, and gastrointestinal tract) or even bleeding originating from the retroperitoneal space, complicating renal or vascular disease (that is, a leaking abdominal aneurysm, renal cysts or tumors). Other serious causes of hemoperitoneum include bleeding as a complication of a medical procedure, varying from endoscopy and paracentesis to erosion of an intra-abdominal vessel associated with placement of a PD catheter. Finally, hemoperitoneum can also be related to bleeding diatheses, including coagulopathies, and to severe uremia (2).

A history of the timing of hemoperitoneum in relation to the menstrual cycle can be useful in associating it either with ovulation or with menstruation. Ovulation can sometimes lead to minimal intraperitoneal bleeding resulting from the rupture of an ovarian follicle during the ovulation process, typically in the middle of the menstrual cycle. Menstruation, on the other hand, can lead to hemoperitoneum by two possible mechanisms: retrograde uterine bleeding and endometriosis of the peritoneal cavity. The first cause can be described as retrograde menses, because uterine endometrial tissue can flux retrogradely into the fallopian tubes, which open into the peritoneal cavity, allowing menstrual blood to enter. In the case of peritoneal endometriosis, bleeding actually originates in the peritoneal cavity, because of the presence of ectopic endometrial tissue (Figure 2) that sheds just like uterine endometrium at the time of menses (3), following the same hormonal signaling. Both causes typically result in a cyclic hemoperitoneum that, in rare cases, can also be associated with the cyclic appearance of symptoms of mild peritonitis as a result of the presence of blood in the peritoneal cavity.

Menses-related hemoperitoneum can potentially be complicated by the development of intraperitoneal adhesions or catheter dysfunction because of obstruction by clots. It can be treated with flushes to rinse out the blood and with intraperitoneal heparin to prevent clot formation.

Because of the upsetting presentation of this condition, every female patient of menstrual age should be advised at the time of PD training about the possibility of hemoperitoneum. This approach is advisable regardless of whether the patient is currently menstruating, because the reappearance of menses after initiation of PD and resolution of uremia-associated amenorrhea has been well described.

**Cancer screening tests**

It is widely appreciated that routine Pap smears and mammograms are recommended as screening tests for cervix and breast cancer for women in the general population. Dialysis patients show an increased incidence of virus-associated cancers. Large population studies have shown that these patients have higher odds of cervical cancer, but not (for example) breast cancer (4). Therefore, in the first instance, Pap smears

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**TABLE 1** “Benign” causes of hemoperitoneum

<table>
<thead>
<tr>
<th>Cause</th>
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<tr>
<td>Menstruation</td>
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<tr>
<td>Ovulation</td>
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<tr>
<td>Bleeding or ruptured ovarian cysts</td>
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<tr>
<td>Bleeding or ruptured renal cysts</td>
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<tr>
<td>Trauma</td>
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<td>Coagulopathy</td>
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**FIGURE 2** Laparoscopic view of lesions of bowel-wall endometriosis. From Camara et al. (3), by permission of Oxford University Press.
Pregnancy

The literature contains no studies of pregnancy in PD with large numbers of patients; only very small case series have been reported. Pregnancy on PD, although it occurs less often, appears to be more successful than in the setting of conventional thrice-weekly hemodialysis. However, in either case, pregnancy has a better outcome if dialysis is started after the patient has already conceived than when the patient becomes pregnant while already on dialysis (7).

Several modality-specific characteristics have been postulated to confer an advantage for PD over conventional hemodialysis. First, PD is associated with more hours of dialysis, and duration of dialysis has been closely associated with outcome, beyond adjustment for the dose of small-solute clearance. The prolonged and gentle dialysis provided by PD can avoid hypotensive episodes that compromise placental blood flow. Another difference with hemodialysis that might contribute to a more favorable pregnancy outcome on PD is the absence of a need for anticoagulation.

On the other hand, a potential problem with PD during pregnancy is the enlarging uterus. The eventual result is a limitation on the peritoneal volume available for dialysis. This consequence can be handled by changing the dialysis regimen, diminishing the dwell volume, and increasing the exchange frequency. Another risk is impaired catheter drainage because of blockage by the growing uterus (10).

Other potential maternal complications that should be expected are a worsening of hypertension and an increase in the requirements for erythropoietin and iron.

Before delivery, the patient should drain the dialysis fluid. Administration of antibiotic prophylaxis for procedure-associated peritonitis is prudent. Most deliveries described in the literature have been by Caesarean section. Even in that case, PD can usually be resumed 2 days after delivery, with the use of small dialysate volumes and frequent exchanges. It should be noted that the infant of an end-stage renal disease patient is born with a blood urea nitrogen level similar to that of its mother, which can result in osmotic diuresis and dehydration.

The risks for preterm labor and small-for-gestational-age infants are common in pregnancies in hemodialysis or PD patients. Moreover, PD-associated

Contraception

Pregnancy occurs less often in PD patients than in patients on hemodialysis (7), and this difference has been postulated to possibly be attributable either to less-adequate dialysis or, more plausibly, to mechanical problems associated with PD technique. The PD fluid might possibly wash away the eggs released by the ovaries during ovulation, because they have to traverse the peritoneal cavity to reach the Fallopian tubes.

Intrauterine devices for contraception are discouraged because there are anecdotal reports of peritonitis associated with their use in PD patients (8). This risk has to be balanced against the risks of an unwanted pregnancy and of the use of other contraceptive methods.

The potential risks of oral contraceptives include exacerbation of underlying hypertension and a higher thrombotic risk, especially if the patient has ongoing heavy residual proteinuria. On the other hand, oral contraceptives have several potential benefits. Apart from reliable birth control, they also offer hormonal supplementation that might be beneficial, because many dialysis patients are sex-hormone-deficient (9). Reacquiring a menstrual cycle might also be helpful by removing the unopposed estrogen exposure effect of amenorrhea and its carcinogenic potential for the uterine endometrium.
peritonitis can precipitate labor. The appearance of hemoperitoneum may be a helpful indication of an obstetrical complication such as abruptio placentae or bleeding of the uterine wall.

Fetal complications include polyhydramnios. The reported incidence varies significantly, ranging from 18% to 100%, as do rates of intrauterine death. Respiratory distress syndrome also seems to occur with a high incidence that has been reported by certain authors to vary from 14% to 80% in preterm and small-for-gestational-age infants. However, overall infant survival has recently been reported to be 76% (11).

**PD-specific problems associated with gynecologic disease**

A rare PD complication that has been reported in female patients is catheter obstruction because of envelopment by fimbriae of the fallopian tube (12).

Another well-described complication of the raised intra-abdominal pressure associated with PD is uterine prolapse. This condition can often be managed conservatively with a vaginal pessary and a change of PD prescription—for example, use of nightly intermittent PD or low-volume day dwells to lower the intra-abdominal pressure.

Leakage of peritoneal fluid through a patent processus vaginalis has been associated with the appearance of labial edema. However, that complication occurs less often than scrotal edema in male patients does, because men more often have a patent processus vaginalis on account of the presence of the spermatic cord.

Vaginal leak of dialysate is another complication that has been described. A disruption in the thin tissue layer that separates the peritoneal cavity from the posterior vaginal dome, in the area of the pouch of Douglas, can allow such leakage through the vagina. The diagnosis can be confirmed by using a dipstick to examine the glucose concentration of the leaking fluid (very high values indicate that it is peritoneal dialysate). Such leaks have occasionally been reported to be associated with peritonitis caused by bacteria of the vaginal flora, including streptococci, *Lactobacillus* species, and yeast.

There is only one report on the management of PD patients who undergo gynecologic surgery. This small series of 5 patients included 3 who underwent hysterectomy. All were temporarily treated with hemodialysis in the immediate postoperative period, and PD was successfully resumed after 2 – 3 weeks (13).

**Summary**

Menstruation resumes or continues in many women on PD. It can be heavy and a source of significant blood loss, and it is occasionally associated with hemoperitoneum. Contraception should be considered for these patients after an individualized evaluation and discussion of the risks and benefits of the various contraceptive methods. Cervical and breast cancer screening tests pose no particular problems in PD, but would be indicated mainly in patients with a good overall prognosis. It is reported that PD patients can successfully carry a pregnancy to live birth, but the complication rate is higher than that seen in the general population. Finally, the presence of dialysate in the pelvis has led to many reports of complications involving the internal and external genitalia.

**Disclosures**

The authors have no conflicts of interest to declare.

**References**


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