Introduction

Peritoneal dialysis is associated with a collection of unique complications apart from peritonitis and those involving the catheter, exit site and tunnel. Some complications are related to increased intra-abdominal pressure, such as abdominal hernias and leaks of dialysis fluid. Other complications are similar to those encountered in haemodialysis patients. Examples of these include dialysis-associated amyloidosis and acquired cystic disease of the kidney. Finally, the long-term presence of dialysis fluid in the peritoneal cavity can result in a rare syndrome of sclerosing encapsulating peritonitis. This chapter will address these and other non-infectious complications of peritoneal dialysis.

Hernias

The presence of dialysis fluid in the peritoneal cavity leads to increased intra-abdominal pressure (IAP). Pressure within the abdomen rises in proportion to the volume of dialysate instilled \cite{1, 2}. The supine patient generates the lowest IAP for a given volume of intraperitoneal fluid. Even in the supine patient on automated peritoneal dialysis, intraperitoneal pressure is closely correlated with the volume of instilled dialysate \cite{3}. Coughing and straining in the sitting and upright positions result in the highest pressures. In addition, patients who are older, and those who are more obese, generate higher IAP for a given activity \cite{2}.

In accordance with Laplace’s law, the tension on the abdominal wall increases with the instillation of dialysate, as a result of the rise in IAP and the larger radius of the abdomen. Increased abdominal pressure and abdominal wall tension lead to hernia formation in those with congenital or acquired defects in or around the abdomen. The areas of weakness are probably very important in the pathogenesis of hernias. Indeed, the IAP in patients with hernias is no different from the pressure measured in those without hernias \cite{4}. A host of hernias has been described in peritoneal dialysis (PD) patients (Table 1). The most common hernia is incisional or through the catheter placement site \cite{5, 6}; in other reports inguinal \cite{7–10} or umbilical \cite{11–13} (Fig. 1) hernias occur most frequently. Asymptomatic hernias are probably quite common and may not be detected until some complication such as bowel strangulation occur. Different centres report a cumulative incidence of 10–15\% of hernias in their PD patients \cite{6, 14}. Patients with hernias tend to be older, female, multiparous, those who have experienced a higher frequency of postoperative leak at the time of catheter insertion \cite{6}, and those who have undergone a previous hernia repair \cite{5}. The mean time for development of hernia is 1 year and the risk increases by 20\% for each year on continuous ambulatory peritoneal dialysis (CAPD) \cite{5}. Patients with polycystic kidney disease may be predisposed to hernia formation and leaks either as a result of higher IAP caused by the large kidneys or as a manifestation of a generalized disorder of collagen \cite{15, 16}.

A major potential area of weakness is the abdominal incision for the implantation of the dialysis catheter. When this incision is made in the midline there is a predilection for incisional hernia to develop because this is an anatomically weak area \cite{17}. Change to a paramedian incision through the rectus
Figure 1. Umbilical hernia in a peritoneal dialysis patient.

muscle has resulted in less perioperative leaks and hernia formation [18].

Another area of potential weakness for herniation is the processus vaginalis. After the migration of the testes in fetal life, the processus vaginalis normally undergoes obliteration. Frequently this does not occur, and the increased abdominal pressure during CAPD may push bowel into the processus vaginalis, resulting in an indirect inguinal hernia. Male paediatric patients may be predisposed to this complication, and if they develop a unilateral inguinal hernia, both sides should probably be repaired prophylactically [19].

Most hernias present as a painless swelling [6]. Bowel has been reported to herniate through the diaphragm at the foramen of Morgagni and present as a retrosternal air–fluid level or juxtacardiac mass [21, 21]. The rate obturator hernia can present with increasing paraesthesia and hyperaesthesia in the thigh [22].

The most worrisome complications are incarceration and strangulation of bowel. This can occur through almost any kind of hernia, but especially a small one. Umbilical hernias may have a particular predilection for bowel strangulation [14]. Hernias may present as a tender lump [23, 24], recurrent Gram-negative peritonitis, bowel obstruction or perforation [6, 25, 26]. Bowel incarceration or strangulation can mimic peritonitis [9, 24, 25] and this complication must be kept in mind, particularly if the site of herniation itself is not obvious.

With the recent trend of emphasis on adequacy of small-solute transport, many patients are being prescribed larger volumes of dialysate such as 2.5 and 3.0 L fill volumes. As discussed, increased fill volumes are associated with increased IAP. It remains to be seen whether the higher fill volumes will lead to an increased incidence of hernias and dialysate leaks. The higher pressures secondary to the bigger volumes may possibly be offset by the growing trend of automated dialysis, wherein the patient dialyses mostly in the supine position. Two recent reports found no increase in the incidence of hernia with larger dialysis volumes, although there was an increase in the use of cyclers, which may have confounded the effect [27, 28].

Treatment of hernias

Hernias warrant surgical repair. Although large ventral hernias carry little measurable risk of bowel incarceration [29] they are unsightly and prone to enlarge. The other types of hernias should be repaired because of the risk of bowel incarceration and strangulation. The patient can be maintained temporarily on low-volume PD preoperatively to allow time for wound healing. Conventional hernioplasty may be followed by the insertion of an overlying polypropylene mesh to reinforce the hernia repair [30]. The addition of the mesh may afford a quicker return to full-volume dialysis [31]. Subsequent development of peritonitis does not appear to