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Catheter placement technique and abdominal wall complications: experience of a peritoneal dialysis unit

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ABSTRACT

Hernia and dialysate leakage from the peritoneal cavity ("leak") are the most important non-infectious abdominal wall complications during peritoneal dialysis and increasingly responsible for permanent transfers to haemodialysis.

Retrospective data from 136 unselected patients treated with peritoneal dialysis in a single centre was analysed and risk factors for the development of leaks and abdominal wall hernias were investigated.

Abdominal wall hernia occurred in 12 patients (9%) during peritoneal dialysis and 8 patients (6%) developed peritoneal leak. Subcutaneous embedding of the peritoneal catheter by Moncrief-Popovich technique was inversely related with peritoneal leak ($p < 0.05$) but not hernia rate. Time to first use of peritoneal dialysis catheter also correlated negatively with leak ($p=0.001$). Hernia incidence was higher in patients with previous abdominal surgery ($p=0.005$), except for hernia repair at the time of catheter placement.

Key-Words:
Abdominal wall hernia; peritoneal leak; subcutaneous embedding.

INTRODUCTION

Hernia and leakage of dialysate from the peritoneal cavity are the most significant non-infectious abdominal wall complications during peritoneal dialysis (PD). The increased intra-abdominal pressure and muscle wasting are thought to be responsible for the high prevalence of abdominal wall complications in patients on PD[1-3]. Prospective reports, however, were unable to show a relationship between high volume dwells and the occurrence of such complications[4].

The defects of the peritoneal cavity boundary can be managed through PD protocol changes directed at lowering intra-abdominal pressure, such as low volume exchanges, intermittent PD or automated peritoneal dialysis (APD) without dwells during daytime. However, there is often a need for surgical correction. Hernias can be complicated by incarceration and bowel necrosis but also reduce patient tolerance to higher PD exchange volumes and can therefore compromise dialysis effectiveness, impelling most authors to advocate hernioplasty. Unremitting subcutaneous swelling or diminished outflow volumes due to frank leakage despite conservative treatment – PD protocol changes or temporary transfer to haemodialysis – may require surgical repair.

Non-infectious complications of PD are increasing over infections as causes of technique failure and transfers to haemodialysis[5].

There is great variation in incidence rates of both hernias and leaks with distinct implantation techniques in various studies and reviews, with contradictory results.

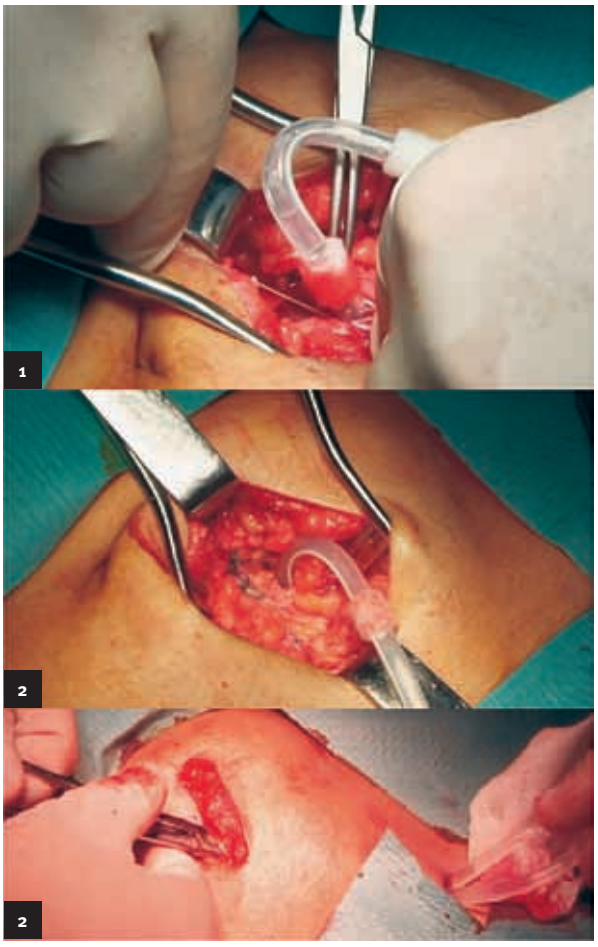
The main aim of this retrospective study was to determine the incidence of clinically significant leaks and hernias in prevalent PD patients and to investigate potential clinical and technical risk factors for their development.

PATIENTS AND METHODS

In this retrospective study, we evaluated the data of a single regional hospital PD Unit. All of the 136 patients treated with PD in the past 16 years in our unit, corresponding to 143 double-cuffed coiled Tenckhoff catheters placed, were studied.

In the first years, catheters were inserted by the nephrologists using the Seldinger technique. After 1995, we began to experiment with a surgical implantation procedure, that of minilaparotomy, to improve visibility of the peritoneal cavity. Later on, in 1997, embedding of the PD catheters by Moncrief-Popovich technique during a minimum period of 4 to 6 weeks was additionally performed in elective patients.

The authors felt these technical changes increased the safety of the procedure and were easy to perform, so since 1999 all catheters in our Unit have been placed by open-dissection/ minilaparotomy of the abdominal wall and left embedded. The posterior rectus muscle fascia and adherent parietal peritoneum leaflet are exposed through a breach of the muscle fibres, after a paramedian incision of the skin, subcutaneous fat and anterior fascia. Both parietal and visceral leaflets are dissected for direct access to the abdominal cavity. After insertion of the Tenckhoff catheter, the peritoneum is tightly closed around it using a pursestring suture. The deep cuff is then placed in the rectus muscle and the anterior rectus fascia entry site is completely sutured. Finally, the catheter is subcutaneously buried (Figures 1-3).



Figures 1 to 3

Minilaparotomy in our Nephrology Unit – technical approaches to prevent abdominal wall complications.

1. Tight closure of the peritoneum around the PD catheter using a pursestring suture.
2. Placement of the deep cuff in the rectus muscle and complete suture of the anterior rectus fascia entry site.
3. Subcutaneous embedding of PD catheter by modified Moncrieff-Popovich technique

The potential relationship between incidence of abdominal wall complications and demographic, clinical and technical catheter placement characteristics was investigated. Age and body mass index (BMI) when starting PD, gender, PD type, follow-up, primary kidney disease, presence of diabetes, catheter placement technique, history of abdominal surgery and time between catheter placement and first use ("embedding time" for those who underwent Moncrief-

Popovich technique and "break-in period" for those whose PD catheter was left exposed) were the main variables studied.. Statistical analyses were performed using SPSS version 17.0. Non-parametric Mann-Whitney and chi-square tests were used to compare means and proportions, due to the reduced number of patients with complications. The Odds ratio were calculated through binary logistic regression. A *p* value ‹0.05 was considered statistically significant.

RESULTS

Mean age was 46.5±16.1 years, 58% were male. Mean follow-up time was 25.8 months, and 26 patients (18.2%) were diabetic. Hypertension and diabetic nephropathy were the main cause of chronic renal disease (24.4% each), followed by IgA nephropathy. One-year survival rate of Tenckhoff catheters was 94%.

Overall, catheter placement was surgical in 107 (74.8%) and percutaneous in 36 (25.2%). In 75 of these procedures (52%), the catheter tip was subcutaneously buried by Moncrief-Popovich technique ("embedding").

Nearly 45% of patients were treated with APD, 52.4% with continuous ambulatory PD (CAPD) and 2.8% with both. Non-infectious complications were registered in 11.9% of patients (n=17).

Abdominal wall hernia

Abdominal wall hernia occurred in 12 patients (9%) during PD, three of which with concurrent leak. Umbilical hernia was the most frequent (10 patients), followed by inguinal and pericatheter (four and two patients respectively), with four patients presenting hernias in more than one location.

Treatment was surgical, with recurrence in three patients, only one with the same location. Global incidence rate was 0.05 hernias/patient/year. History of abdominal surgery prior to PD initiation correlated with abdominal wall hernia development (p=0.001; OR 6.9), due to increased frequency of incisional hernia (two patients). We did not, however, find a higher hernia incidence in patients with surgically placed catheters (7% *vs*. 11%). The presence of multiparity was not assessed.

Five patients had pre-existent abdominal wall hernias surgically repaired along with the minilaparotomy for catheter insertion and none of these patients developed hernia during PD treatment.

Hernia rates did not differ according to subcutaneous embedding of the catheter or time to first use. Both pericatheter hernias (n=2) occurred in patients without Moncrief-Popovich and time to first use under 15 days.

There was no correlation between age, gender, diabetes, PD type, BMI and hernia incidence. We could not find a significantly higher rate of hernia for any cause of primary kidney disease, including ADPKD (one in three patients). Results are summarised in Table I.

Table I

Clinical characteristics of PD patients developing hernias

	With hernia	Without hernia	*p* value
Patients (n)	12	131	
Mean age (years)	47.7±15.2	46.4±16.2	0.8
Gender (male/female)	7/5	76/55	1.0
Diabetes	1 (8.3%)	32 (27.4%)	0.63
BMI	24.3±3.0	23.3±3.2	0.76
Type of PD (CAPD/APD/both)	6/6/0	69/58/4	0.79
Implantation (surgical/Seldinger)	8/4	99/32	0.49
Subcutaneous embedding	3 (25%)	72 (55%)	0.07
Time to first use (days)	38.1±58.6	61.4±71.6	0.27

Dialysate leaks

Eight patients (6%) developed peritoneal leakage, corresponding to a global incidence of 0.034 leaks/patient/year. The treatment consisted of change to APD, intermittent PD or temporary transfer to haemodialysis for at least one month. Only two leaks persisted, despite several trials of conservative treatment, including one-month transfer to haemodialysis.

Leaks were slightly more frequent in older individuals and females.

There was no significant correlation between PD type, BMI, cause of primary kidney disease, prevalence of diabetes and leak incidence.

Of the eight patients developing leakage, five had their PD catheter surgically implanted. Analysing the relative frequencies, we found that 9.1% of the patients with percutaneous insertion of the PD catheter had leak as compared to 4.9% of leakage in the catheters inserted through minilaparotomy. The use of Moncrief-Popovich technique was inversely related with peritoneal leak (p ‹0.05) – only one patient developed a peritoneal leak (rS -0.2 p ‹0.05; OR 9.2, p ‹0.05). The time interval between catheter placement and first use was significantly shorter in patients with peritoneal leak; mean 15±10 days in patients who developed leak *vs.* mean of 62±72 days in patients without leak; p=0.001. Immediate use of the PD catheter was related to a higher leak rate (OR 8.75 for leak with time to first use ‹1 month, p ‹0.05). Results are summarised in Table II.

Table II

Clinical characteristics of PD patients developing leaks

	With leak	Without leak	*p* value
Patients (n)	8	135	
Mean age (years)	46.7±16.4	43.9±8.9	0.43
Gender (male/female)	2/6	81/54	0.07
Diabetes	4 (50%)	29 (24%)	0.2
BMI	24.3±3.0	23.3±3.2	0.75
Type of PD (CAPD/APD/both)	4/3/1	71/61/3	0.23
Implantation (surgical/Seldinger)	5/3	102/33	0.4
Subcutaneous embedding	1	74	0.03
Time to first use (days)	15.1±10.4	62.1±71.9	0.001

DISCUSSION

Hernia prevalence in PD patients is reported as between 9 to 27%[6-12], with an incidence rate of 0.06-0.08 per PD-year at risk[4,6,7]. Dialysate leakage prevalence rates vary from 2.9 to 22.5% in recent papers[4,6,13-18]. We had a low rate of non-infectious complications. Although well within these reported average rates, the retrospective nature of the study and the solely clinical diagnosis of hernias and leaks may have underestimated the real incidence. Small hernias can often go undetected in the physical examination of regular PD consultations, unless the patient is aware of the importance of its early diagnosis and correction. Leaks may require a peritoneal scintigraphy or CT scan for a correct diagnosis, in a number reaching one-third in late occurring leaks[19].

Age has been described as a risk factor for abdominal wall complications[20], but we could not find any such relationship.

ADPKD was found to be a risk factor for abdominal wall herniation in several studies[4,13], but the small number of patients with this cause of primary kidney disease in our cohort (n=3) made it difficult to find a correlation between the conditions (one in three ADPKD patients developed hernia).

The supine position and consequently lower intra-abdominal pressure during APD could lower the rate of abdominal wall complications in these patients compared with CAPD[2,7] but we found similar rates of hernia and leaks in both groups. Also, the infusion volumes were actually lower in the patients developing abdominal wall complications, even when normalising the volume in relation to patient BMI. Other studies have failed to demonstrate a higher risk for such complications in high volume dwells PD protocols[4].

There are contradictory reports concerning the incidence of abdominal wall complications with distinct techniques for the insertion of PD catheters. Laparoscopic placement has the benefit of enabling simultaneous correction of adhesions, omentectomy or suturing of the catheter pig-tail end to avoid migration but is an expensive technique. Open surgery and blind percutaneous procedures require less technical expertise, making them more suitable for small centres. However, with appropriately trained physicians placing PD catheters in experienced renal units, all implantation techniques may provide good results. Different randomised studies attain conflicting results and so far, no implantation technique has definitely been shown to be superior to the others, so there are no specific guidelines or recommendations[21,22].

In our experience, there was no significant correlation between non-infectious complications incidence rates and PD insertion technique. In the group of patients with percutaneous catheter insertion, hernias occurred in 11%, a slightly higher percentage than patients with surgically placed PD catheters (7.5%). PD catheter implantation by the attending nephrologist gives our PD unit a higher degree of autonomy from the surgeon in the management of PD access and initiation of dialysis. Minilaparotomy

is an open surgery, quick, technically simple, outpatient implantation procedure that can easily be executed by the specialised team of nephrologists.

Subcutaneous embedding is associated with a very low incidence of leakage, none being registered in the smaller series[14,17,18]. Burial of the PD catheter tip allows better healing of the operative wound, avoiding the increased intra-abdominal pressure of peritoneal dwells in the post-operative period. The length of time catheters remain embedded has correlated with the incidence of leakage in previous reports[17]. In our patients, catheter embedding reduced the risk of leak (OR: 9.2).

A tighter securing of the PD catheter to the peritoneum during insertion can help reduce abdominal wall complications, as an alternative to Moncrief-Popovich technique allowing a shorter break-in period. A low leak rate (4%) with this modified percutaneous technique was demonstrated in a study published in 2008 with 48 PD patients[15].

The increased risk of hernia in patients with abdominal wall incisions from previous laparotomies was expected, as the cicatricial tissue represents a weakness in the muscle layers that can easily be breached. The minimal disruption of muscle fibres and the complete suture of the anterior rectus fascia entry site during minilaparotomy probably contributed to the lack of association between the surgical insertion and hernia development.

None of the patients that had pre-existent hernias repaired before PD initiation developed hernia later on, contrary to reports that state the history of previous herniation as a risk factor for hernia during PD[13]. This could be a bias due to the reduced follow-up (mean 25.8 months) of this cohort of patients, since hernioplasty protects only from local relapse.

In conclusion, surgical insertion of the PD catheter with subcutaneous embedding by a specialised team of nephrologists allowed a timely management of the PD access with the same approach as the vascular access for haemodialysis. Using this approach, we observed a low rate of leakage and abdominal wall hernia.

Conflict of interest statement. None declared.

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