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Evaluation of Medical Insertion of Peritoneal Dialysis Catheters

Tahawar A Rana*, Hilary Cramp, Jacob A Akoh

South West Transplant Centre, Directorate of Surgery & Renal Services, Plymouth Hospitals NHS Trust, Derriford Hospital, Plymouth PL6 8DH, United Kingdom

Abstract:

Background and Aims: Percutaneous insertion of peritoneal dialysis catheters (PDC) by nephrologists is gradually gaining favour due to its convenience for patients and financial benefits. This study was carried out to determine the outcomes of this procedure and to compare it with catheters inserted by surgeons during the same period.

Methods: A retrospective review of PDC insertion by percutaneous (medical) and open (surgical) techniques was carried out in a Renal Unit at a University Teaching Hospital serving a population of 450,000. All patients going onto peritoneal dialysis were considered for medical insertion of PDC, except for those with previous PDC insertions, abdominal operations or obesity. All patients who had PDC insertions for peritoneal dialysis between January 2005 and September 2008 were included and followed up to the completion of the study. The main outcome measures were technique success, primary failure (failure within the first month) and complications beyond the first month.

Results: One hundred and twenty PDCs were inserted (69 medical, 51 surgical) in 97 patients. The primary failure rate for first insertions was 16.7% for medical and 10.5% for surgical insertions, but the difference was not significant (P = 0.72). Peritonitis, the most common complication, was treated successfully in 25 of 30 patients. Secondary blockage was similar for medical (13%) and surgical insertions (12%). Exit site infections were significantly higher in the surgical group (P = 0.04), while PD peritonitis was more common with medical group (P = 0.47). The number of PDC removed due to complications was higher in the medical (23%) than the surgical group (16%), but not significantly (P = 0.38). Median survival of PDC was similar in both groups.

Conclusions: Percutaneous insertion of a PDC by a motivated and suitably experienced nephrologist offers significant advantages provided careful patient selection is applied. Medical insertion of PDC is safe and reduces pressure on precious operating theatre time.

Keywords: Peritoneal Dialysis Catheter, Medical Insertion, Surgical Insertion, Primary Failure, Peritonitis

Introduction

Although haemodialysis is the predominant dialysis modality in the United Kingdom, peritoneal dialysis (PD) plays a significant role. According to figures from the UK Renal Registry (2008) there were 746 patients per million population (pmp) on renal replacement therapy in the United Kingdom, of which 323 pmp were on haemodialysis (HD) and 76 pmp were on PD (1).

*Correspondence:
Tahawar A Rana, MBBS, FRCSEd
Clinical Fellow Renal Transplant SurgeryLevel 04 Derriford Hospital, Plymouth PL6 8DH United Kingdom
Tel:+44 1752 439798
Fax:+44 1752 774651
Email: ranatahawar@yahoo.com
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Insertion of peritoneal dialysis catheters (PDC) has traditionally been carried out by surgeons in an operating theatre often under general anaesthesia (GA). Recently, this procedure has been performed more and more by interventional nephrologists under local anaesthesia (2). This involves the use of fluoroscopy in many centres to help in pelvic placement of the PDC and early diagnosis of bowel perforation (3). However, using careful technique it is possible to perform this procedure in a treatment room or ward setting (2). This approach avoids taking up precious theatre time and is therefore more economical. In addition, it avoids the use of contrast (albeit in small amounts) in patients with compromised renal function. A dedicated PDC insertion service also cuts down on waiting times for the procedure (4).

This report covers practice in a Renal Unit (managing 125 patients on HD and 55 patients on PD) at a University Teaching Hospital which serves a population of 450,000. A few PDCs had been inserted percutaneously prior to 2004, which showed good results as well as demonstrating safety and economic benefits. It was then decided to start a formal percutaneous PDC insertion service and a consultant nephrologist with a special interest in percutaneous intervention was appointed in 2004. This lead to a gradual rise in the use of medical insertion of PDCs and the aim of this study is to determine the safety, efficacy and outcome of percutaneous insertion of PDCs by nephrologists, and compare it to surgical insertions during the same period.

Materials and Methods

Inclusion Criteria

All patients who had PDCs inserted at a University Teaching Hospital between January 2005 and September 2008 for peritoneal dialysis were included in the study. Eight patients who had PDC insertions for drainage of ascites were excluded. The choice of PD as a modality was influenced by patient's choice, availability of HD slots, previous abdominal surgery and acute or chronic presentation of renal failure. All patients were considered for a medical insertion except those who had previous PD catheter insertions, a scarred abdomen due to previous laparotomy or required a simultaneous surgical procedure. In the later part of the study period medical insertions were carried out in selected patients with a history of previous operations (including previous PDC insertions).

Procedure

All patients received the curled Tenchkoff catheter (Quinton Curl Cath, Tyco Healthcare Group LP, Mansfield, MA, US). One consultant nephrologist and her team of registrars carried out the medical insertions under local anaesthesia (LA), while the surgical insertions were carried out by two consultant surgeons under GA or LA. Patients were provided training regarding the use of their PDCs and PD was initiated between 1 to 4 weeks post insertion depending upon patient's circumstances and technique used (usually one week for surgical insertions and two weeks or more for medical insertions).

Surgical Technique

Surgical insertions involved a 3 to 4cm longitudinal paraumbilical incision. The anterior rectus sheath was exposed and then opened longitudinally. The rectus muscle was retracted laterally to expose the posterior rectus sheath. A purse string suture of 2/0 Vicryl (Polyglactin) was placed in the posterior sheath and a small opening made carefully within the purse string to avoid damaging the internal viscera. The catheter was then introduced over an introducer, which was gradually slid along the anterior abdominal wall (to avoid visceral injury) and directed into the pelvis. Normal saline was infused into the catheter to ensure free flow and drainage. The purse string suture was secured and the catheter rechecked to ensure free flow. The anterior rectus sheath was then repaired with number 1 Vicryl. The

catheter was tunnelled subcutaneously and brought out inferolaterally at a previously marked spot in the lower quadrant of the abdomen. The incision was closed with subcuticular 3/0 undyed Vicryl.

Medical Technique

Insertion of PDC by nephrologists was performed in the treatment/procedure room adjacent to the renal ward. A 2-3cm longitudinal or transverse infraumbilical incision was made after infiltration of local anaesthetic. The linea alba was lifted up between two haemostats and a small opening made in the midline. A wide bore needle was used to gain access to the peritoneum. A flexible guidewire was passed into the peritoneal cavity and the needle removed. A dilator was passed over the guidewire to dilate the opening. The dilator was then removed leaving the guidewire in situ. A second dilator with an external sheath was introduced over the guidewire. This second dilator and the guidewire were then removed and the PDC introduced through the sheath, which was then split and removed carefully to avoid dislodging the PDC. Some dialysate fluid was then infused through the PDC and the effluent allowed to drain to exclude mechanical obstruction intestinal perforation or bleeding. The external portion of the PDC was tunnelled to the exit site and the infraumbilical incision closed.

Data Collection

Data on patients were retrieved from the case notes, PD folders, PD nurse's records, and the renal computer database (PROTON Information System, Clinical Computing, PLC, London, England). Information including age, sex, aetiology of renal failure, indication for insertion, previous surgery, previous PDC insertions, insertion technique, outcome and complications were entered into an MS Excel datasheet and used for this analysis. History of abdominal procedures, additional procedures carried out at time of insertion, date for starting PD, complications like leakage, blockage (primary – at insertion or within the first month, or later), perforation of viscus, peritonitis and exit site infection were also recorded.

Statistics

The main outcome measures were technique success, primary failure and complications beyond the first month. Primary failure referred to catheter malfunction due to any cause within the first month of insertion or inability to use it for PD prior to its removal. The average survival of PD catheter was calculated from the date of insertion to the date of PD failure, catheter removal, transplantation or patient death (with a functioning PDC). The data was statistically analysed (mean, median, Chi square [X2] with Yates correction [degree of freedom: dF = 1] and P value [two-tailed]) using MS Excel, the Graphpad® website (www.graphpad.com) and SPSS 16® software. A P value of less than 0.05 was considered statistically significant.

Results

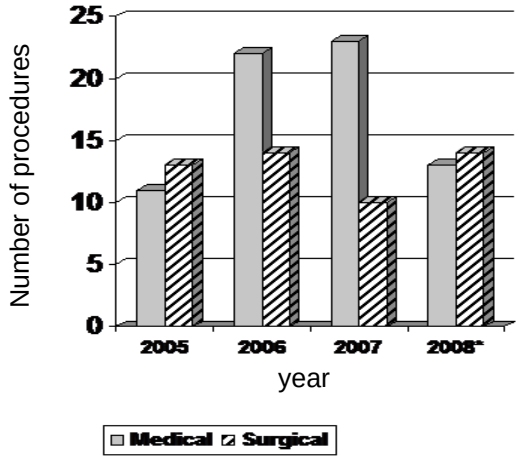
During the study period, a total of 120 PD catheters were inserted in 97 patients (49 male and 48 female) giving an average 1.23 PDC per patient. Fourteen (14.5%) patients had renal failure secondary to diabetes mellitus, while in ten it was due to hypertension (10%). The cause for renal failure was not known in 25 patients (26%).

The number of medical insertions rose steadily from 11 in 2005 to 23 in 2007 (Figure 1). Table 1 shows a comparison of medical and surgical PDC insertions. The 2 medical re-insertions (after primary failure in the medical group) were performed in the latter part of the study period.

Indications for surgical insertion were previous abdominal surgery in 22 (43%). Other indications of surgical insertion included simultaneous removal and insertion of PD catheter in 23 (45%) and need for simultaneous hernia repairs in 3 (6 %). Obesity,

needle phobia and unsuitability for sedation (due to sleep apnoea syndrome) were the indications for surgical insertion in the remaining three patients. The 23 patients receiving a second PDC included 5 patients who had their first PD catheters inserted before the period of this study (Table 1). The primary failure rate was 11/67 (16.4%) and 2/19 (10.5%) for medical and surgical insertions respectively and the difference was statistically not significant ($X^2 = 0.174$; dF = 1; P = 0.6763). Among the failed surgical PDCs one had a simultaneous inguinal hernia repair at the time of catheter insertion and went on to have a successful second surgical insertion. The other patient had a second unsuccessful surgical insertion where many peritoneal adhesions were found, but went on to have a renal transplant 2 months later.

Figure 1. Number of peritoneal dialysis catheters inserted by year



* Nine months data only

Table 1. Comparison of medical and surgical PDC insertions

	Medical (N = 69)	Surgical (N = 51)	P value
Previous abdominal surgery	10	22	
First catheter insertion	67 (97.1%)	19 (37.3%)	0.0001
Second insertions	2 (2.9%)	23 (45.1%)	
Third insertions	0	7 (13.7%)	
Fourth insertion	0	2 (2.9%)	
Primary Failure for first insertions	11/67 (16.4%)	2/19 (10.5%)	0.78
Median days before starting PD (Mean±SD)	19 22±10.33	18 21±12.8	
Median catheter survival (months) (Mean±SD)	12 (15.27±11.05)	11.5 (13.3±11.26)	

The complications of PDC according to the method of insertion are shown in Table 2. One patient from the medical group suffered a bowel perforation that was detected at the time of insertion when aspiration revealed faeculent fluid. She was managed conservatively and went on to have a surgical insertion which functioned for 21 months till her death from an unrelated cause. Of the nine (13%) medical insertions complicated by leakage around the PDC, one had a small hole in its wall through which fluid leaked into the subcutaneous tissues. The rate of secondary blockage (blockage after a period of use for PD) was similar for medical (13%) and for surgical insertions (12%). However, the rate of exit site infections was statistically significantly higher in the surgical group ($X^2 = 5.30$; dF = 1; P = 0.02). Conversely, the rate of PD peritonitis was higher for the medically inserted PDC - 20 (29%) compared to 10 (19.6%) for surgical insertions though it was not statistically significant ($X^2 = 0.921$; dF = 1; P = 0.34).

Table 2. Long term PDC related complications

Complication	Medical (N = 69)	Surgical (N = 51)	P value
Peritonitis	20 (29%)	10 (19.6%)	0.34
Exit site Infection	4 (5.8%)	11 (21.6%)	**0.02**
Mechanical/Drainage Problems	9 (13%)	6 (11.8%)	0.83
Leak	9 (13%)	5 (9.8%)	0.067
Bowel perforation	1 (1.4%)	0	-

Table 3. Current status of PDC according to method of insertion

Outcome	Medical (n = 69)	Surgical(n = 51)	P value
Functioning			
Active	20 (29%)	15 (29.4%)	0.96
Dialysis not needed or transplanted	14 (20.3%)	5 (9.8%)	
Died/withdrew treatment	5 (7.2%)	8 (15.7%)	
TOTAL	39 (56.5%)	28 (55%)	0.86
Removed			
For late blockage	8 (11.6%)	5 (9.8%)	0.98
For peritonitis	4 (5.8)	1 (2%)	0.56
For Leakage	3 (4.3%)	1 (2%)	0.84
For exit site infection	1 (1.4%)	1 (2%)	0.83
TOTAL	16 (23%)	8 (15.7%)	0.38
Lost to follow up	2 (2.9%)	2 (3.9%)	

Follow up ranged from 6 to 50 months. Twenty (29%) of the medical and 15 (30%) of the surgical group were still on PD at the end of the follow up period (Table 3). Two patients from each group were lost to follow up as the patients had relocated to another area. Though the number of PD catheters removed due to complications (leakage, blockage, peritonitis and exit infection) was higher in the medical group at 16 (23%) than the surgical group (8; 16%), the difference was not statistically significant ($X^2 = 0.38$; dF = 1; P = 0.748). PDCs that are either still in use or had been removed due to transplantation, improvement in renal function or patient death were labelled as 'functioning'. Survival rates were 56.5% (39/69) for medical and 55% (28/51) for the surgical insertions, which didn't differ statistically ($X^2 = 0.031$; dF = 1; P = 0.86). The mean±SD PDC survival was 15.27±11.05 months for the medically inserted PDC compared to 13.23±11.26 months for the surgical group (Table 1).

Discussion

Recent changes in practice have led to the conversion of PDC insertion from an inpatient episode to day case at our centre. Such improvements in the surgical service in the absence of dedicated renal lists have not dented the waiting time for access surgery in renal patients. Waiting times for access surgery still remain unacceptably long due to time lost to processing referrals, making space on operation theatre lists, pre-anaesthetic assessment and other

patient factors. Percutaneous / medical insertion of PDCs by nephrologists has the advantages of decreasing the overall waiting time for surgery (4) and would be cost effective if the results are as good as for surgically inserted catheters. It has also been shown to improve utilisation of PD as a modality, especially if there is a dedicated PD access team (4, 5).

Previous reports about the safety and efficacy of percutaneous insertion of PDC have been based on a technique involving the use of fluoroscopy (3), which exposes the patient to radiation and contrast material. Other techniques like peritoneoscopy and laparoscopy (6, 7) require special instruments and their maintenance, which adds to the cost. Even though the patient populations were different and the incidence of mechanical dysfunction is relatively high, the contribution of medical PDC insertion to the overall CAPD service is significant, which is in keeping with the experience in other centres (4, 5) Our experience shows that it is possible to safely insert PDCs in a treatment room facility without the use of fluoroscopy or peritoneoscopy. This approach cuts down substantially on establishment and maintenance costs. The only patient who suffered a bowel perforation in this study was from the medical group, but this was detected at the time of the operation due to the practice of observing the effluent after placing the PDC. The fact that the patient responded to conservative treatment and went on to a successful surgical PDC insertion further illustrates the fact that careful technique and vigilance can avert major complications. The risk of intestinal perforation is increased if unexpected adhesions are encountered. The importance of early detection of visceral injury, including intestinal perforation, cannot be overemphasised as this could have potentially dangerous consequences if left unattended. Dialysate fluid should be infused and the effluent watched closely for any possible intestinal contents.

Another advantage of the percutaneous insertion technique is that the procedure is relatively easy to train experienced renal specialist registrars in. At our centre registrars typically observed five procedures and performed five under direct supervision before undertaking the procedures under indirect supervision. For peritoneoscopic insertion a trainee is required to perform at least 23 procedures before being considered proficient (8).

PDC failure is defined as 'early' if it occurs in the first 30 days (2). Two of the 19 first time surgical insertions failed in the first month, both due to obstruction. Nine of the 11 medical failures were due to obstruction, the remaining two were due to PDC leakage. The commonest indications for a second PDC insertion in this series were obstruction (10.8%), peritonitis (4.1%), and leaks (3.3%). This pattern of complications is similar to Basile et al (2) but differs from others (9, 10) who found that second insertions were due to peritonitis in 48%, with catheter malfunction and leaks accounting for 30%. By performing omentectomy at the time of PDC insertion Reissman and co-workers reported a low catheter obstruction rate of 2% (11), however this procedure was not routinely practised at our centre due to the associated morbidity of a full laparotomy. Vijt et al (12) reviewed PDC insertion in 49 centres (298 patients) and showed that 50% needed treatment for catheter related complications in the rest period between insertion and first use. Although a major Cochrane database system review (13) of 17 trials (1089 patients) failed to demonstrate any major advantages with various catheter related interventions, it is reasonable to assume that the higher rate of peritonitis in the medical group could be due to the shorter distance between the skin incision and the entry of the catheter into the linea alba. In the surgical technique the catheter was passed through the posterior rectus sheath. This allowed the rectus muscle to cover the entry of the catheter into the peritoneum. In addition the repair of the anterior rectus sheath adds an additional protective layer to the site of entry of the catheter into the peritoneal

cavity. This should also explain the lower rate of leakage from the catheter in the surgical group.

A waiting period of at least two weeks was used for all medically inserted PDC. Surgically inserted PDC were used after one week with good results. The reason for a slightly longer period of wait before using medically inserted PDC was to allow the Dacron cuff to bed down to surrounding tissues and avoid leaks. During surgical insertion the peritoneum is tightly closed around the PDC and leaks are uncommon. Stegmayr 2003 (14) used three purse string sutures to secure the PDC and allowed patients to start PD immediately after insertion without increasing the incidence of early leakage. Another technical issue is the site of PDC placement. Use of midline incision for PDC placement is controversial (15, 16). It is thought that the percutaneous approach via the midline leads to poor transmural fixation of the PDC, predisposing to catheter tip migration to a position of poor drainage function or to within reach of the omentum. This may explain the rather high PDC blockage rate in this study. The long term effects of either approach may be difficult to determine in this study given the duration of follow up. However, a period of wait before initiation of PD would seem to decrease early PDC leaks.

The higher rate of primary failure (26%) in the surgical group is probably accounted for by the type of patients selected. A strict comparison of the two methods of insertion is hence not possible due to the different patient populations treated. For example, Mallotte et al (17) chose patients who were too ill to have an open surgical procedure for percutaneous insertion, and not surprisingly reported poorer results than in those treated by surgeons. Sampathkumar and co-workers (18) used a larger (7.3±0.65cm) paramedian or lateral incision in their surgical series, but excluded patients with a history of previous abdominal surgery. Though they reported no complications in the surgical group compared to the percutaneous PDC group, their hospital stay was inordinately high compared to this series. It is important to note that in their series the patient populations were similar but choice of technique was not randomised as the patient populations were not contemporary. Chen et al (19) however, found no significant increase in complication rates in patients who had previous abdominal surgery.

The reported rate of PDC complications during the first month (39% surgical insertions, 26% medical) compares favourably with the 31% reported by Tiong (20). Although the mean number of catheters inserted per patient (1.23) in our series is similar to theirs (1.17), their reported median survival time of 42 months is much higher. This review highlights the need for concerted efforts to improve the survival of PDCs whether inserted medically or surgically. Catheter salvage measures under consideration include the use of laparoscopy to relocate displaced catheters, free encased catheters from adhesions or omental wrap, or omentectomy. Adoption of such measures should lead to better results in future.

Conclusions

Percutaneous insertion of a PDC by a motivated and suitably experienced nephrologist offers significant advantages provided careful patient selection is applied. Medical insertion of PDC is safe and cost effective and reduces pressure on precious operating theatre time. Where suitable nephrological expertise exists, surgical insertion of PDC in uncomplicated patients should become a fallback option.

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Conflict of interest

None declared.

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