Surgical complications of Tenckhoff catheters used in continuous ambulatory peritoneal dialysis

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ABSTRACT

Introduction: The objective of this study was to audit the early and late complications of open Tenckhoff catheter insertion under local anaesthesia in a single institution.

Methods: A review was carried out on 164 insertions in 139 patients over a three-year period. All patient records were retrospectively analysed until the time of transfer to haemodialysis, death, or to current time if alive and receiving continuous ambulatory peritoneal dialysis (CAPD). Patient characteristics, operative factors, early and late complications were recorded.

Results: Early complications were reported in 31 percent of catheter insertions, predominantly wound infections and catheter malfunctions. The factors that were significantly associated with early complications were diabetes mellitus, glomerulonephritis, ongoing sepsis, previous abdominal surgery and prolonged surgical time. Late complications were seen in 26 percent of catheter insertions, mainly CAPD peritonitis. Poor nutritional status had a significant negative impact on late complications. The overall median catheter survival time was 41.9 months (95 percent confidence interval, 25.8-58.0 months). In addition, no significant difference in catheter survival time was detected between those patients with and those without diabetes mellitus.

Conclusion: Tenckhoff catheter insertion for CAPD is a procedure associated with significant surgical morbidity. Patients with diabetes mellitus, glomerulonephritis and ongoing sepsis are at greater risk of early complications, and hence, must have their conditions stabilised or treated before surgery. In addition, prolonged surgical time and patients with previous abdominal surgery are at increased risk. The rate of complications may be improved by early consideration of patients with poor tolerance of local anaesthetic surgery or with previous abdominal surgery for laparoscopic insertion under general anaesthesia. To prevent late complications dominated by CAPD peritonitis, patients' nutritional status and care of the catheter should both be optimised.

Keywords: continuous ambulatory peritoneal dialysis, end-stage renal failure, peritoneal dialysis, peritonitis, postoperative complications, Tenckhoff catheter

Singapore Med J 2006; 47(8):707-711

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INTRODUCTION

Since 1976, continuous ambulatory peritoneal dialysis (CAPD) has been increasingly used as an alternative to haemodialysis for the treatment of patients with end-stage renal failure[1,2]. This is due to its potential advantages of a more liberal dietary intake of protein, potassium and sodium. It is also associated with fewer symptoms of haemodynamic instability during dialysis, resulting in better tolerance by patients with ischaemic heart disease[2,3]. In addition, there is no requirement for anticoagulation and access to the circulatory system. There are also studies showing that CAPD patients enjoy a better quality of life with better patient mobility and lower cost[4].

In Singapore, there are currently about 2,000 patients undergoing dialysis, of whom 680 (34%) are treated with CAPD[5]. Despite its widespread use, complications related to the peritoneal dialysis (PD) catheter have hampered its success. Both early and late complications have reportedly limited catheter survival of 50% to 60% at 18 months, and 35% to 51% at 24 months, respectively [6-8]. Hence, the ideal method for the insertion of PD catheters remains debatable. Although the most common technique is an open surgical approach, other methods for placement including laparoscopic, peritoneoscopic and radiological approaches have been described. No direct

head to head comparisons have been performed. This study aims to review the surgical experience, including complications and outcomes, of open Tenckhoff peritoneal dialysis catheter insertion at our institution. This would facilitate identification of factors associated with complications and of deficiencies with the open technique.

METHODS

This was a retrospective review of consecutively implanted catheters from 2000 to 2003. There were a total of 164 insertions in 139 patients. 71 (51%) were male and 68 (49%) were female. The mean age of patients was 63.1 years (range 32-93 years). All patients had end-stage renal failure, with the various causes shown in Fig. 1. Of the patients treated, 123 (89%) had no previous renal replacement therapy, while the remaining 16 (11%) patients were transferred from haemodialysis. 82% of the patients had other comorbidities, with 46% of patients suffering from ischaemic heart disease and 18% of patients with previous cerebrovascular accidents.

Day surgery was utilised for 68 (41%) of the catheter insertions to minimise hospital stay for the patients. The remaining insertions were performed as inpatient procedures, either because the patients were already inpatients undergoing other medical treatment including haemodialysis, or due to patients' wishes for a hospital stay overnight. A team of urological surgeons, comprising consultants, registrars and fellows, performed all the insertions. All catheters used were double-cuff Tenckhoff catheters. Under local anaesthesia, the catheters were inserted using an open lateral transrectus muscle technique via a paramedian transverse skin incision. The catheter was directed into the pelvic cavity using a guidewire.

Following placement, its Dacron cuff was secured to the peritoneum via a purse string 2/0 vicryl suture. The catheter was then tunnelled subcutaneously to a separate skin exit site from the main wound, which was closed in layers with 3/0 vicryl to the rectus sheath and interrupted prolene to skin. The inflow and outflow were checked by flushing with diasylate fluid and confirmed to be good before patient discharge. Following discharge, patients were reviewed initially at two weeks for the removal of sutures, then at one month for CAPD training and start of dialysis. All intraoperative and postoperative problems, unscheduled admissions, and complications were retrospectively analysed.

All the statistical analysis was performed using SAS version 8.0 (SAS Institute Inc, Cary, USA).

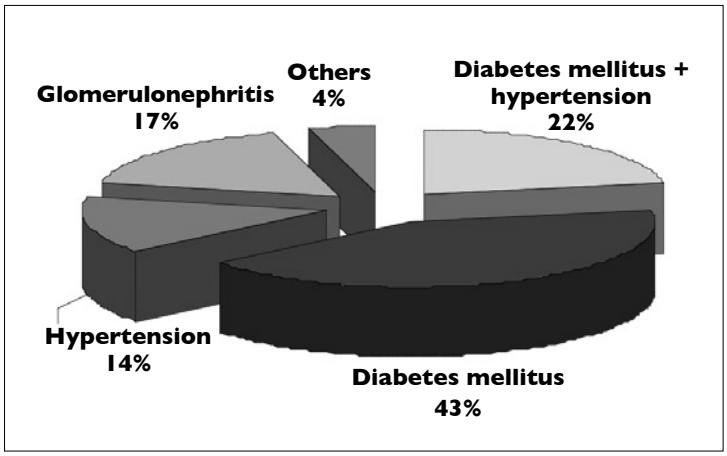

Fig. 1 Pie chart shows causes of end-stage renal failure patients undergoing Tenckhoff catheter insertion.

The studied outcomes were early complications, late complications and catheter survival time. The predictors noted were age, gender, body mass index, causes of renal failure, previous abdominal surgery including previous reinsertion, grade of surgeon performing the insertion, duration of surgery, and serum albumin levels. The correlation between early or late complication and the predictors were assessed using a generalised linear model. The comparison of catheter survival time between patients with or without diabetes mellitus was analysed using Kaplan-Meier technique with log rank test statistic. Statistical significance was assumed if $p<0.05$.

RESULTS

Early complications

There were no significant intraoperative complications and no deaths were directly attributable to the catheter insertion. There were no cases that required conversion to general anaesthesia intraoperatively. Early complications, defined as complications within 30 days of the operation, occurred in 50 (31%) of catheter insertions, necessitating the removal of 14 (8.5%) of the catheters. The different causes are shown in Table I. Of note, exit site and wound problems together accounted for 58% of the early complications, and malposition and flow problems accounted for 24% of the early complications.

Of the causes of renal failure, 33% of the catheter insertions on the patients with diabetes mellitus had early complications compared to 27% on the patients without diabetes mellitus ($p<0.01$, odds-ratio [OR]=3.24, 95% confidence interval [CI]=1.66-6.33). Catheter insertions on patients with glomerulonephritis also had a significantly higher incidence of early complications compared with others. (35% vs 30%, $p<0.01$, OR=6.52, 95%

Table I. List of the early complications following Tenckhoff catheter insertion.

Early complication (≤30 days)	Number of cases (% of total)	Number of catheters consequently removed (% of total)
Wound haematoma/infection	19 (38%)	3 (22%)
Malposition/poor flow	12 (24%)	6 (42%)
Exit site haematoma/infection	11 (22%)	2 (14%)
Early peritonitis	3 (6%)	3 (22%)
Pericatheter leakage	3 (6%)	0
Others	2 (4%)	0
Total	**50**	**14**

Table II. Causes of end-stage renal failure patients undergoing Tenckhoff catheter insertion.

Late complication (>30 days)	Number of cases (% of total)	Number of catheters consequently removed (% of total)
CAPD peritonitis	36 (84%)	21 (81%)
Blockage/poor flow	5 (12%)	4 (15%)
Scrotal swelling	2 (4%)	1 (4%)
Total	**43**	**26**

CI=2.26-18.80). Early complications were not associated with other causes of renal failure including hypertension.

18 (41.9%) catheter insertions on those patients with previous abdominal surgery including previous insertions, had early complications compared to 32 (26.4%) of insertions on those patients without previous abdominal surgery (p=0.02, OR=3.42, 95% CI=1.18-9.87). Hence, early complications were significantly more common in patients with previous abdominal surgery and previous Tenckhoff insertions. The overall mean duration of surgery was 58.8 minutes (range 20-170 minutes). However, patients who suffered early complications had a significantly longer average duration of surgery (mean 62.8 minutes, standard deviation [SD] 27.0 minutes) compared with those without early complications (mean 56.9 minutes, SD 21.2 minutes) (p=0.02).

With regard to the level of surgeon's experience, consultants had 14 early complications out of 51 insertions (27.5%), registrars had 31 cases of early complications out of 99 insertions (31.3%), and fellows had five early complications out of 14 insertions (35.7%). Early complications were not significantly associated with the grade of surgeon performing the surgery (p=0.80). In addition, there was no significant difference in the duration of surgery between consultants (mean 53.7 minutes, SD 24.0 minutes), registrars (mean 61.6 minutes, SD 22.8 minutes) and fellows (mean 57.4 minutes, SD 21.6 minutes) (p=0.15).

Three patients developed CAPD peritonitis within 30 days of the insertion of Tenckhoff catheter, prior to actual start of peritoneal dialysis. A review of the patients' case notes showed that all three patients had ongoing sepsis (two patients had superficial skin abscess in the groin and forearm, respectively, and one patient had an above knee amputation wound infection) when they had the catheter insertion. Hence, patients with septic conditions are at risk of developing early peritonitis with catheter insertion, even if the site of sepsis is distant from the site of insertion.

The mean body mass index was 23.4 (range 16.1-35.1). There was no significant association found between increased body mass index and early complications (p=0.81). Mean albumin levels at the time of insertion, used as an approximate marker for nutritional status, was 30.2 g/dL (range 14-44 g/dL). No significant association was detected between early complications and albumin levels (p=0.57). Lastly, there was no significant association between early complication and patients' age and gender.

Late complications and catheter survival

Late complications are defined as complications occurring 30 days post-insertion of Tenckhoff catheters. The incidence of the different late complications, which occurred in 43 (26.2%) of the catheters, are shown in Table II. The mean duration of use of CAPD was 15.3 months (range 1-40 months), and a total of 1,547 patient months was reviewed. CAPD peritonitis was the main cause of late complications and also accounted for the majority of catheters removed after the 30 days. There was a significant association between albumin levels and late complications (p<0.001), with a mean albumin level of 27.6 g/dL (SD 7.0 g/dL) in patients with late complications and a mean of 31.1 g/dL (SD 5.8 g/dL) in those without. Albumin levels were measured at the time of catheter insertion. Interestingly, there was no significant association of late complications with patients' age, gender or cause of renal failure, including diabetes mellitus and glomerulonephritis. As expected, late complications were not associated with operative factors, including previous abdominal surgery, catheter reinsertions or the occurrences of resolved early complications.

The median overall catheter survival time was 41.9 months (95% CI 25.8-58.0 months). As 62% of

our patients with end-stage renal failure undergoing CAPD had diabetes mellitus, there was concern that patients with diabetes mellitus had poorer outcomes on CAPD. Hence, Kaplan-Meier analysis was performed to compare the catheter survival time between patients with and without diabetes mellitus (Fig. 2). The median catheter survival time for diabetic patients was 32.5 months (95% CI 19.1-55.8 months) and that for non-diabetic patients was 41.9 months (95% CI 21.2-62.6 months). No significant difference in catheter survival time was detected (p=0.36).

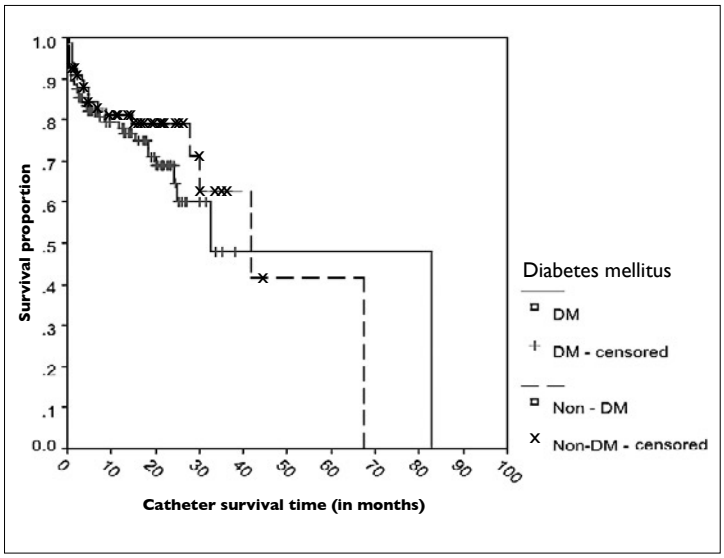

Fig. 2 Kaplan-Meier survival analysis of catheter survival time between diabetic and non-diabetic groups. The graph for patients with diabetes mellitus is represented by the full line and the graph for patients without diabetes mellitus is represented by the dashed line.

DISCUSSION

Peritoneal dialysis has now become an established form of renal replacement therapy. It offers many advantages, but it is still associated with a significant number of complications. Our early complication rate of 31% was primarily accounted for by wound or exit site infection and catheter malfunction. This is comparable to previous reports of wound infection rates of up to 20% and catheter malfunction rate of 30%[6-8]. It is essential to identify associated patient and surgical factors leading to complications to facilitate the identification of corrective measures. Patients with diabetes mellitus and glomerulonephritis have a higher risk of early complications. An immunocompromised state and poorer wound-healing ability in these conditions could account for the association with early problems postoperation. Good sugar control in patients with diabetes mellitus preoperatively may therefore decrease the incidence of early complications and we now ensure that patients have blood sugar levels within the normal range on the day of surgery. In addition, a prophylactic dose of antibiotics – a third generation cephalosporin – is given prior to surgery for all patients.

Previous abdominal surgery results in intraabdominal adhesions, which accounts for the significantly increased risk of early complications arising from problems of catheter malfunction in these patients. Intraabdominal adhesions increase the risk of catheter tip malposition, catheter migration or kinking, as well as tube blockage. These patients often require a second corrective surgery. Therefore, in patients with previous abdominal surgery including previous Tenckhoff catheter insertions, laparoscopy may have a useful role in assessing the degree of adhesions, performing adhesiolysis, and in accurate positioning of the Tenckhoff catheter tip. In patients with catheter malfunction, laparoscopy has already been successfully advocated as a minimally invasive corrective measure[9], especially if the cause is omental wrapping of the catheter tube.

Prolonged surgical duration is associated with early complications. This probably reflects increased surgical difficulty. Surgical difficulties may arise in patients who poorly tolerate the insertion of catheter under local anaesthesia or in patients with intraabdominal adhesions from previous abdominal surgery. Hence, at our institution, following discussion with the patients and risk assessment by the anaesthetist, we now offer laparoscopic insertion of Tenckhoff catheters under general anaesthesia for patients with poor tolerance of local anaesthetic surgery and for patients with previous abdominal surgery including previous Tenckhoff catheter insertions. A prospective comparison of outcomes for laparoscopic and open insertions of Tenckhoff catheters in these patients is being carried out and results are awaited. Interestingly, patients with greater body mass index are not associated with greater early complications. This may be because the majority of our Asian population patients were within the normal range of body mass index (BMI), and only a few were morbidly obese (BMI>35).

It is important to note that early CAPD peritonitis was invariably associated with on-going preoperative sepsis. This was so even if the cause of sepsis was at a distant body site. Hence, all infection in patients should be treated before the placement of Tenckhoff catheter and all principles of prosthetic surgery should be closely adhered to ensure absolute asepsis. As expected, CAPD peritonitis was the primary cause of late complications and delayed catheter failure. Although difficult to prove, this was often related

to patient care of the catheter and the adequacy of aseptic techniques during the use of the catheter for dialysis. Interestingly, while low albumin levels were not associated with early complications, they were significantly associated with late ones. Serum albumin levels are an approximate marker for nutrition in the absence of acute inflammation and patients with low albumin levels may reflect poor nutrition and decreased resistance to intraperitoneal sepsis, as in patients with liver cirrhosis. Recent reports have confirmed that malnutrition, assessed by nutrition risk index which takes into account the serum albumin, is an independent risk factor for nosocromial infections[10]. Hence, clean catheter care and good nutritional status are important factors for decreasing the rate of late complications.

Our data shows that for patients with diabetes mellitus, no significant difference could be found in long-term catheter survival when compared to patients without diabetes mellitus. Therefore, although patients with diabetes mellitus suffer from increased early complications, CAPD using Tenckhoff catheter remains a viable option for renal replacement therapy in the long term. It seems that if measures can be taken to minimise early complications in patients with diabetes, it should not be a selection criteria for the use of Tenckhoff catheters.

In conclusion, Tenckhoff catheters for CAPD remains associated with significant morbidity. This study has identified patient and surgical factors, which were significantly associated with early and late complications. A multi-disciplinary approach between renal physicians and surgeons should be undertaken to optimise these factors prior to surgery to minimise complications. Medically, good blood sugar control in patients with diabetes mellitus, adequate treatment of infection at all body sites and prophylactic antibiotics before surgery are vital to preventing early complications. To address the surgical factors that contribute to early complications, we are now conducting a prospective trial that provides the option of laparoscopic insertion of Tenckhoff catheters under general anaesthesia for selected patients with previous abdominal surgery and for those who poorly tolerate local anaesthetic operations. This will ensure accurate and effective placement to decrease catheter malfunction, and hopefully prevent prolonged surgical time. To prevent long-term complications dominated by CAPD peritonitis, careful training and retraining of patients in aseptic care of the catheter by both nursing and medical teams are vital. Optimising these patients' nutritional status from the time of insertion may be beneficial in decreasing CAPD peritonitis.

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