The Malta experience: a retrospective study of two types of peritoneal dialysis catheters

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Abstract

Aim: The aim of this retrospective study was to compare the one year and two year survival rate of the double cuff coiled Tenchkoff catheter (TC) and the double cuff coiled Swan Neck (SN) catheter. The incidence of the following complications in the two groups were assessed: exit site infection (ESI), tunnel infection (TI), peritonitis (P), flow problems (FP), catheter tip migration (CTP), hernia development (H) and leakage (L).

Methods: This is a retrospective comparative study of peritoneal dialysis catheters inserted between January 2003 and December 2008 by one surgical team at Mater Dei Hospital.

Results: The one year catheter survival rate was TC 88.5% and SN 90%. There was no statistically significant difference in catheter survival rate between the two cohorts. The survival rate at 2 years post implantation of the TC catheters was 82.6% and 88.8% for the SN catheters.

Conclusions: Equally good results were obtained with the two types of peritoneal dialysis catheters studied. There was no significant difference in 1 and 2 year survival between the two types of catheters. In our local experience the catheter survival rate and episodes of peritonitis per year at risk are in line with the recommendations of the International Society of Peritoneal Dialysis (ISPD).

Keywords

Catheter survival, continuous ambulatory peritoneal dialysis, peritoneal dialysis, peritonitis, straight coiled catheter, swan neck catheter

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Introduction

Peritoneal dialysis has been used for treatment of renal failure since 1923, twenty years before the introduction of haemodialysis.[1] The double cuff Tenchkoff catheter developed in 1968 for intermittent peritoneal dialysis is also widely used for continuous ambulatory peritoneal dialysis (CAPD).[2] Since then various modifications of the original Tenchkoff catheter have been devised to minimise catheter-related complications and their associated morbidity and mortality.[3-7]

The renal unit in Malta is based at the Mater Dei Hospital which is a University teaching Hospital. This renal unit was set up in 1983 at St. Luke's Hospital. The unit was then transferred to Mater Dei Hospital in November 2007.

Aim

The aim of this retrospective single centre study was to compare the outcome of two types of peritoneal dialysis catheters in current use at the renal unit at Mater Dei Hospital. The catheters are the double-cuff coiled Tenchkoff catheter (TC) and the double-cuff coiled Swan Neck Missouri catheter (SN). The main outcome measures of this study were the one and two year survival rates of the respective catheters. The incidence of the following complications were assessed: exit site infection (ESI), tunnel infection (TI), peritonitis (P), flow problems (FP), catheter tip migration (CTP), hernia development (H) and leakage (L) .

Methodology

Patients who underwent peritoneal dialysis catheter insertion by one surgical team between January 2003 to December 2008 were identified from the surgical operations database of the surgical team carrying out the study. A data collection sheet was prepared to enter the relevant data by retrospective review of the case notes. These data were then entered into a Microsoft Excel Spread sheet for analysis .

The data collection sheet included the following exclusion criteria:

- death of patient within one year from date of implantation of catheter
- patient had undergone previous peritoneal dialysis catheter/s
- patient had previous intra-abdominal surgery not retroperitoneal surgery
- hernia repair done simultaneously with the catheter implantation.

***Table 1**: Demographic characteristics of the two cohorts (n=46). TC= Tenchkoff catheter, SN=Swan neck catheter, NS=Not significant.*

Type of Catheter	TC	SN	*p* value
Number of specific catheter type	26	20	NS
Age range (years)	4-78	23-83	
Mean age (years)	52.8	62.7	NS
Median age (years)	54	67	
Male: Female ratio	15:11	15:5	
Number of deaths	10	0	

During the selected study period the catheter implantations were performed by either of two surgeons with equal experience working in the same surgical firm. All catheters were implanted under general anaesthesia. Insertion of the straight coiled Tenchkoff catheter was by a midline subumbilical approach. A paramedian approach through the rectus muscle was used for the Swan Neck catheter. No omentectomies were performed and the distal cuff was positioned 2-3 centimetres proximal to the tunnelled exit site.[8] Post-operative wound and catheter care was standard in both types as per protocol of our local renal unit.

Statistical analysis

Data were entered into a Microsoft Excel spread sheet. A statistical calculator programme (statcalc.exe) was used to analyse the data. A two tailed probability value of < 0.05 was deemed statistically significant. 95% confidence intervals were applied.

Results

Between January 2003 and December 2008, 61 peritoneal dialysis catheters were implanted by surgical dissection. Fifteen (24.6%) of these were not included in the study on the basis of the exclusion criteria listed above. Forty-six of these patients met the inclusion criteria and were included in the study. Twenty six of these (56.5%) were straight coiled double cuffed Tenchkoff catheters (TC) and twenty (43.5%) were Swan Neck Missouri coiled double cuffed catheters (SN).

The demographic characteristics of the two cohorts are shown in Table 1. Table 2 illustrates the duration in months of the implanted catheters. The mean duration of the implanted catheters was significantly longer ($p<0.0429$) in the TC cohort (27.8, 95% CI 3.55 months) than in the SN cohort (20.8, 95% CI 2.87 months).

The one year catheter survival rates of the two types of peritoneal dialysis catheters implanted are represented in Table 3. The one year catheter survival rates were TC: 88.5% and SN: 90%. There was no statistically significant difference in catheter survival rate between the two cohorts.

Outcome of Tenchkoff catheters by the end of the first year post implantation

By the end of the first year three Tenchkoff catheters were lost due to catheter complications One was removed 4 months post insertion due to exit site infection and unresolving peritonitis. This patient was switched to permanent haemodialysis. The second one was replaced by another Tenchkoff catheter 12 months post implantation due to peritonitis not responding to medical treatment. The third catheter was also replaced by another Tenchkoff catheter 12 months post insertion due to persistent leakage. This gave a catheter failure rate or a technical failure rate in the first year post implantation of 11.5%.

Outcome of the Swan Neck Missouri catheters by the end of the first year post implantation

One SN catheter was replaced by a similar one 11 months post insertion due to exit site infection and unresolving peritonitis. The other was replaced by another at 6 months post implantation due to flow problems. In the SN catheter cohort two catheters were lost during the first year. Therefore this cohort had a one year catheter failure rate of 10%. The difference in catheter failure rate between the two types was not statistically significant ($p=0.9613$).

***Table 2:** Duration of Peritoneal Dialysis Catheters (months)*
TC= Tenchkoff catheter, SN=Swan neck catheter, NS=Not significant.

Type of Catheter	TC	SN	*p* value
n	26	20	NS
Range	4-55	6-34	
Mean	27.8 (95%CI 3.55)	20.8 (95%CI 2.87)	$p<0.05$
Median	29	21	

Table 3: *Peritoneal dialysis catheter survival rates at end of first year and end of second year*

Catheter survival rate	1 year			2 year		
Type of catheter	TC	SN	*p* value	TC	SN	*p* value
Sample size	26	20	NS	23	18	
No. of catheters lost	3	2		4	2	
% Catheter survival rate	88.5	90	NS	82.6	88.8	NS
95% Confidence intervals	88.5±4.9	90±5.0		12.0	12.75	

TC= Tenchkoff catheter, SN=Swan neck catheter, NS=Not significant.

Outcome of the Tenchkoff catheters by the end of the second year post implantation

Table 3 shows the catheter survival rate at the end of the second year post implantation.

Once again, there was no statistical significant difference between the two cohorts. During this second year the TC cohort suffered 4 catheter failures due to complications and 4 patients passed away. The TC cohort had a catheter failure rate of 17.3%. The survival rate at 2 years post implantation of the TC catheters (82.6%) was calculated on the true technical failures assuming that if the other four patients survived the catheters would not have failed. One patient developed an incisional hernia 21 months post insertion. The catheter was replaced by a similar during the repair but peritoneal dialysis was resumed after a period of haemodialysis to allow wound healing .Another TC catheter was replaced by a SN catheter due to unresolving exit site , tunnel infection and finally peritonitis. The third case was switched to permanent haemodialysis due to flow problems and the fourth one was converted to permanent haemodialysis due to both flow problems and peritonitis.

Outcome of the Swan Neck Missouri catheters by the end of the second year post implantation

During the second year post catheter implantation, the SN cohort had no deaths. However, by the end of the second year two SN catheters were removed. One had relapsing episodes of infection at the exit site and the other due to repeat episodes of peritonitis. This cohort had a 2 year catheter survival rate of 88.8% and a catheter failure rate of 11.1%.

Table 4: *Catheter complication incidence rate per year at risk*

Incidence rate /year at risk			
Type of catheter	TC	SN	Total
Exit site infection	0.149	0.086	0.252
Tunnel infection	0.049	0	0.063
Peritonitis	0.182	0.317	0.463
Leakage	0.033	0.028	0.063
Hernia	0.049	0.028	0.084
Flow problems	0.028	0.028	0.042
Catheter tip migration	0	0	0

TC= Tenchkoff catheter, SN=Swan neck catheter, NS=Not significant.

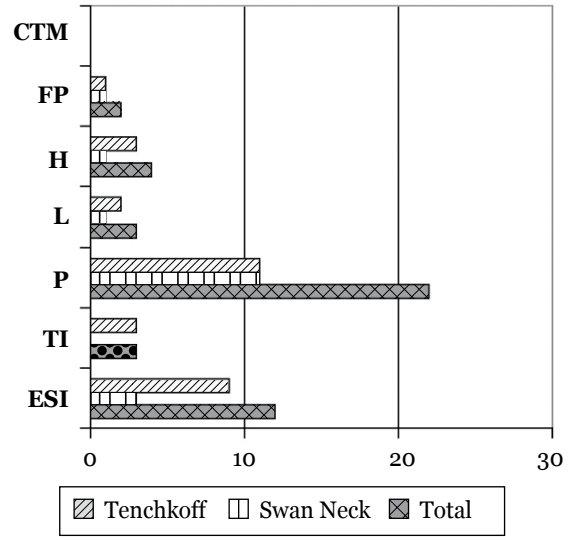
Outcome in terms of catheter complications

Figure 1 illustrates the type and number of episodes of complications per catheter type. The dialysis years at risk for the TC cohort was calculated to be 60.4 years, for the SN cohort it was 34.6 years and for the total sample studied this was 47.5 years. Table 4 represents the incidence rate per year at risk of the individual catheter complications for the different catheter types and totally.

Discussion

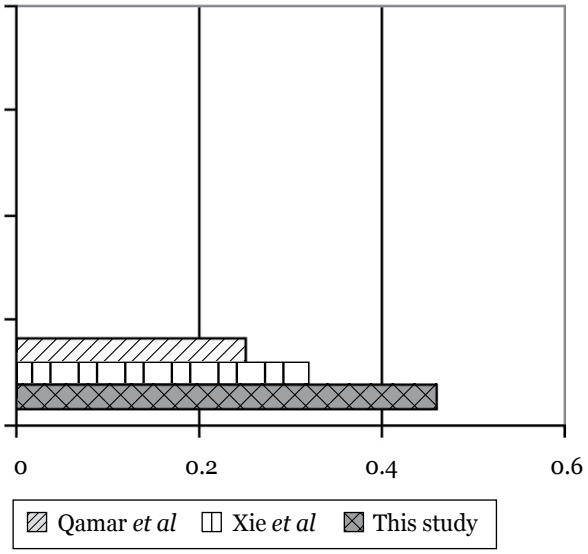
The International Society for Peritoneal Dialysis Guidelines recommend that a catheter survival rate at 1 year of >80% is a reasonable goal.[8] In our experience the 1 year and 2 year catheter survival rate for the TC and SN catheters were 88.5%, 82.6% and 90%, 88.8% respectively. These are good results

Figure 1: *Type and number of catheter complications*



CTM=catheter tip migration; FP=flow problems; H=hernia; L=leakage; P=peritonitis; TI=tunnel infection; ESI=exit site infection

Figure 2: *Episodes of peritonitis per year at risk*



even though there was no statistical difference between the two types of catheter. Several studies have shown no advantage of bent catheters over straight catheters[9-11] while others have shown better results.[6,12] The one year catheter survival rate for our unit is more accurate or unbiased as those patients who died during the first year following catheter implantation were excluded from the study. During the second year there were 4 deaths in the TC cohort but none in the SN cohort. The other exclusion criteria applied uniformly through out the study period in both cohorts. The statistically significant difference in the duration of the two types of catheters is due to the fact that more of the TC catheters were done in the earlier part of the study period.

The fixed arcuate bend in the design of the Swan neck catheters was to diminish cuff extrusion and catheter tip migration associated with the straight catheters implanted in arcuate tunnels by surgical dissection. Studies have shown lower rates of exit site infections with Swan neck catheters but no difference in rate of peritonitis.[10] Figure 1 demonstrates that our results are consistent with the papers referred to in our study. The number of episodes of exit site infection, tunnel infection, leakage and hernia were numerically less frequent in the SN cohort than in the TC cohort. However, the episodes of peritonitis and flow problems in the two types of catheters were the same. No catheter tip migration was reported in the two cohorts. These figures are further illustrated in Table 4 which expresses the number of types of episodes in terms of incidence per year at risk. These figures were compared with those of the Renal Electrolyte Division at the University of Pittsburgh. This institute published a paper on clinical outcomes in peritoneal dialysis in 2009.[13] In this unit the peritonitis rate between 2005 and 2007 was 0.25 episodes per year at risk. In our unit whereas the total peritonitis rate was 0.463 episodes per year at risk, the SN and TC cohorts had a rate of 0.317 and 0.182 episodes per year at risk respectively. Our results however, compare well with those of Xie et al[14] who reported a peritonitis rate of 0.32 times per year globally, 0.35 time per year at risk for the SN cohort and 0.29 times per year at risk for the TC cohort (Figure 2). On the other hand, the exit site infection rate during the same period of time in the American study was 0.1 episode per year at risk. In our study the total exit site infection rates was 0.25 episodes per year at risk. However, for the TC and SN cohorts the rates were 0.149 and 0.086 episodes per year at risk respectively. These figures show that our overall peritonitis and exit site infection rates are higher than in the American study. However, when one analyses the rates for the two local cohorts the SN cohort has a higher peritonitis rate but lower exit site infection rate relative to the TC cohort. One has to keep in mind that overall the number of actual episodes of peritonitis in the two cohorts were the same but the sample sizes of the cohorts were different (TC n=26, SN n=20).

The ISPD guide lines recommend that a centre's peritonitis rate should not exceed more than one episode every 18 months (0.67 per year at risk).[8] However rates as low as 0.23 to 0.29 have been reported in the literature as the American study quoted illustrates. In our experience this study confirmed that our unit is in line with the international recommendations in terms of both survival rate and incidence of peritonitis per year at risk. The latter is an important measure as it influences both catheter and patient survival.

However, in spite of the satisfactory results, the authors would like to point out that the study

had its limitations. The inclusion and exclusion criteria laid down were aimed at minimising external influences from affecting the true survival rate of the catheters *per se*. This resulted, however, in a small sample size. The study was a retrospective one and this could have confounding influences on data collection and interpretation.

Conclusion

In our local experience the catheter survival rate and episodes of peritonitis per year at risk are in line with ISPD recommendations. There was no statistically significant difference in the survival rates of the two types of catheters. The more frequent episodes of peritonitis per year at risk in the SN cohort and the more frequent episodes of exit site infections in the TC cohort need to be assessed more closely. This could provide the basis for future studies.

Equally good results were obtained with the two types of peritoneal dialysis catheters studied. We were unable to demonstrate any significant advantage of one type of catheter over the other.

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