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Videolaparoscopy as rescue therapy and placement of peritoneal dialysis catheters: a thirty-two case single centre experience

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Abstract

Background. Malfunction of the peritoneal catheter is a frequent complication in peritoneal dialysis (PD). Videolaparoscopy is a minimal invasive technique that allows rescue therapy of malfunctioning catheters and consecutive immediate resumption of PD. Furthermore, Tenckhoff catheters can be safely positioned in patients with previous abdominal surgery. We analysed the clinical diagnosis, videolaparoscopic treatment and the outcome of PD patients on whom videolaparoscopic interventions had been performed at our centre.

Methods. Thirty-two cases of videolaparoscopic interventions were performed for salvage of malfunctioning peritoneal catheters, implantation and abdominal surgical interventions in 25 PD patients. The videolaparoscope was inserted through a mini-laparotomy site of 15 mm diameter which was closed with purse-string sutures at the end of the intervention.

Results. Videolaparoscopy was used in 21 cases of catheter malfunction mostly due to omental wrapping (12 cases) and dislocation (five cases). In eight patients with previous surgical abdominal interventions, laparoscopic placement of the PD catheter was performed. In two cases the gall bladder was removed. One case of intestinal occlusion was evaluated laparoscopically in an attempt to minimize invasive surgery. Leakage of the peritoneal fluid presented the only complication caused by insufficient closure of one mini-laparotomy site. Minimal follow-up time of rescued catheters was 5 months. Videolaparoscopy prolonged PD catheter function by a median of 163 days (range 5–1469 days).

Conclusions. Videolaparoscopy prolongs peritoneal catheter survival by treating directly the causes of malfunction. In patients with preceding abdominal interventions, the PD catheter can be placed safely even in cases necessitating surgical preparation like adhesiolysis.

Keywords: catheter; implantation; peritoneal dialysis; revision; videolaparoscopy

Introduction

Peritoneal catheter malfunction is a common complication of peritoneal dialysis (PD) necessitating urgent restoration of catheter function. Options for conservative, non-surgical management are enema, forced flushing of the catheter, urokinase administration and manipulation by metal guide wire or Fogarty catheter. Failure to restore catheter function by the above mentioned methods calls for surgical intervention under visualization of the abdominal cavity or replacement of the catheter [1].

Since the early 1980s, peritoneoscopy has been used for placement [2] and revision of malfunctioning peritoneal catheters [3], making possible limited inspection of the peritoneal cavity. Percutaneous implantation of PD catheters under peritoneoscopy is performed using the 2.2 mm Y-TEC peritoneoscopic system with the 3 mm Quill catheter guide. The technical possibilities for rescue therapy of malfunctioning peritoneal catheters are limited, since peritoneoscopy is performed with scopes of small diameter.

Videolaparoscopy (VLS) substituted peritoneoscopy, after the first experiences in gynaecology and abdominal surgery, and was furtheron applied in PD [4–7]. VLS utilizes larger scopes with several ports for surgical instruments, thus making possible the more complicated procedures such as omentectomy and catheter fixation in PD patients. The possibility to perform adhesiolysis at the time of catheter implantation makes PD accessible especially to patients with previous abdominal surgery [8,9].

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In this publication, we present our single centre 10-year experience with 32 videolaparoscopic cases for rescue, implantation and surgical interventions.

Subjects and methods

VLS was introduced at our dialysis centre in March 1995. Until March 2005 a total of 32 videolaparoscopic interventions were performed in 25 PD patients (mean age 64 years). The interventions were undertaken by a team composed of a surgeon and one or two nephrologists. Clinical diagnosis and type of intervention are listed in Table 1. Existing equipment available to any institution that regularly performs laparoscopic surgery was utilized.

VLS was mainly performed under general anaesthesia. Only in six cases was local anaesthesia used under supervision of the anaesthesiology team, similar to an already published protocol [10]. In these cases the duration of the laparoscopic procedure was limited to 5–10 min. It was utilized for exploration of the abdominal cavity for PD catheter placement in patients with preceding laparotomies and low probability of extensive adhesions.

The peritoneal access consists of one to three mini-laparotomy sites of 15 mm diameter.

A purse-string suture is performed around every peritoneal aperture in order to obtain a tight closure without leakage at the end of the intervention.

At the site of the first mini-laparotomy, mostly in a pararectus location, a laparoscopic port with a diameter of 10–12 mm was inserted and pneumoperitoneum with carbondioxide at a pressure of 12 mmHg is created, followed by exploration of the abdominal cavity using a videolaparoscope (0-degree Laparoscope, 10 mm shaft diameter, Karl Storz, Tuttlingen, Germany). The additional one or two mini-laparotomy sites were created consecutively and were used for surgical instruments. We used trocars, with uniform dimensions in order to change the insertion site of the videolaparoscope, if necessary. At the end of the intervention the pneumoperitoneum was released, the purse-string sutures were tightly closed and the abdominal wall was closed layer by layer.

PD catheter placement under videolaparoscopic control was performed in patients with previous abdominal surgery or in the case of a malfunctioning catheter, which had to be substituted.

After the configuration of a mini-laparotomy access at the standard paramedian position, the abdominal cavity was explored with the patient in the Trendelenburg position. The VLS port was directed to the pelvic space, the PD catheter was inserted and the purse-string suture was tightened below the internal cuff of the catheter after the removal of the VLS port. Thus, the internal cuff will be completely buried in the subfascial space of the rectus sheet musculature. Closure of the mini-laparotomy access site in an oblique manner from the lower to the upper part ensures maintaining the direction of the catheter towards the pelvic space. A curved tunneler was used to create the exit site in a lateral downward oriented position [11].

Prophylactic antibiotic therapy consisting of 1 g vancomycin intravenously was given prior to the intervention. In all patients, straight Tenckhoff catheters with two cuffs of different manufacturers were used.

From March 1995 to March 2005, a total of 76 PD double-cuffed straight Tenckhoff catheters were implanted in 72 patients at our centre, using VLS in 10 cases and the classical open surgical technique in the remaining cases. Six patients were referred to our centre because of catheter malfunction in order to perform a videolaparoscopic intervention.

Peritoneal catheter malfunction was defined as poor outflow of dialysate (more than 30 min/2 l exchange), obstruction or complete occlusion to inflow and outflow resulting in inadequate PD or precluding the use of continuous cycle PD.

All cases of catheter malfunction were evaluated by an antero-posterior abdominal radiograph. Dislocation was radiographically defined as migration of the catheter tip from the pelvis to the upper abdomen. Pericatheter leaks were excluded by ultrasound examination. Malfunction was primarily treated in a conservative manner including enema and manipulation by metal guide wire or Fogarty catheter as necessary.

Statistical analysis

The incidence rate of catheter malfunction necessitating VLS intervention was calculated on the basis of catheters placed at our centre. Prolongation of catheter function by videolaparoscopic intervention was evaluated. Technical survival of the peritoneal catheter was estimated using the method of Kaplan and Meier with censoring for voluntary change to haemodialysis, kidney transplantation and death with a functioning catheter. Differences in survival were analysed using the Gehans' Wilcoxon test.

Results

The most frequent clinical indication necessitating a videolaparoscopic intervention was malfunction of the PD catheter in 21 of 32 interventions (Table 2). VLS was also used for exploration of the abdominal cavity and placement of PD catheters in patients with preceding abdominal interventions (eight cases) and for cholecystectomy (two cases). In the case of intestinal occlusion (case 25) VLS was performed in an attempt to minimise invasive intervention, but had to be converted into laparatomy as small bowel necrosis was present.

The most frequent cause of PD catheter malfunction necessitating VLS intervention was wrapping (13 of 21 cases) mainly by omental tissue (12 cases), followed by dislocation of the PD catheter (five of 21 cases) and the combination of the two above mentioned conditions (three of 21 cases). Intraluminal thrombosis was present in three cases. The different videolaparoscopic diagnoses in cases of PD catheter malfunction are listed in Table 3, together with the prevalence rate in our VLS series and the incidence rate during the study period.

The first episode of catheter malfunction occurred mostly in the first 2 months after traditional catheter positioning (10 cases). In five cases there was a late onset of dysfunction (>6 months after placement), necessitating for the first time a videolaparoscopic intervention.

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Table 1. Peritoneal dialysis patients treated by videolaparoscopy (chronological order)

Case	Patient	Sex	Age	Time	Indication for VLS	Diagnosis	Treatment	Anaesthetic	Outcome
1	A.Am.	F	82	1	dysfunction	wrapping	stripping	gen.	relapse after 26 months→Case 3
2	F.M.	F	75	1	dysfunction	catheter malposition	repositioning, fixation	gen.	functioning for 16 months→†
3	A.Am.	F	84	27	dysfunction	wrapping	stripping, fixation	gen.	relapse after 3 months→Case 4
4	A.Am.	F	84	30	dysfunction	wrapping	removal of fixation and catheter	loc.	HD
5	M.G.	M	85	31	dysfunction	dislocation	repositioning, fixation	gen.	functioning for 9 months→†
6	S.M.	F	60	2	dysfunction	dislocation	repositioning, fixation	gen.	thrombus after 24 months→Case 13
7	L.E.	M	75	n.a.	implantation, cholecystectomy	cholecystolithiasis	cholecystectomy, implantation	gen.	scrotal edema after 2 months→HD
8	F.Mi.	F	59	25	dysfunction	dislocation	repositioning, fixation	gen.	functioning for 5 months→HD
9	A.M.	F	53	n.a.	implantation, previous surgery	no adherences	implantation	loc.	hydrothorax after 4 months→HD
10	F.S.	M	43	1	dysfunction	wrapping, intestinal perforation	stripping, suture of perforation	gen.	functioning (24 months)→HD°
11	M.L.	F	81	33	dysfunction	dislocation	repositioning	gen.	relapse after 10 days→HD
12	R.G.	M	76	65	dysfunction	catheter thrombosis, peritonitis	stripping, removal of thrombus	gen.	peritonitis for 10 days→HD
13	S.M.	F	62	26	dysfunction	catheter thrombosis	removal of thrombus and fixation	gen.	functioning (48 months)*
14	G.E.	M	79	2	dysfunction	wrapping, cuff malposition	removal of catheter, implantation	gen.	functioning for 2 months→†
15	C.S.	F	48	11	dysfunction	wrapping	stripping	gen.	relapse after 5 days→Case 16
16	C.S.	F	48	11	dysfunction	wrapping	partial omentectomy	gen.	functioning for 7 months→Case 19
17	S.T.	M	51	0	dysfunction	wrapping	partial omentectomy	gen.	relapse after 5 months→Case 18
18	S.T.	M	51	1	dysfunction	wrapping, dislocation	stripping, fixation	gen.	relapse after 2 months→HD
19	C.S.	F	49	18	cholecystectomy	cholecystolithiasis	cholecystectomy	gen.	functioning (33 months)*
20	P.J.	F	71	1	dysfunction	dislocation	repositioning, fixation	gen.	functioning (32 months)*
21	C.A.	F	71	n.a.	implantation, previous surgery	no adherences	implantation	loc.	peritonitis after 5 months→HD
22	F.R.	F	77	n.a.	implantation, previous surgery	no adherences	implantation	loc.	functioning for 4 months→†
23	S.O.	M	72	n.a.	implantation, previous surgery	adherences	adhesiolysis, implantation	loc. →gen.	functioning for 4 months→†
24	L.J.	F	78	1	dysfunction	wrapping, occlusion by peritubal tissue	stripping, removal of occlusion	gen.	functioning (17 months)*
25	M.E.	F	52	7	intestinal occlusion	laparocele, small bowel necrosis	laparotomy, bowel resection, removal of catheter	gen.	HD
26	A.A.	M	62	n.a.	implantation, previous surgery	adherences, suspect of liver cirrhosis	adhesiolysis, liver biopsy, implantation	loc.→gen.	functioning (13 months)*
27	D.D.	M	34	2	dysfunction	wrapping, dislocation	stripping, fixation	gen.	relapse after 5 months→Case 30
28	S.Ma.	M	68	1	dysfunction	wrapping	stripping	gen.	functioning for 7 months→HD
29	B.M.	F	50	n.a.	implantation, previous surgery	adherences	implantation	gen.	functioning (5 months)*
30	D.D.	M	34	7	dysfunction	wrapping, dislocation	stripping, reposition, partial omentectomy	gen.	functioning (5 months)*
31	M.M.	M	79	n.a.	implantation, previous surgery	adherences	implantation	gen	functioning (4 months)*
32	M.Ma.	F	51	n.a.	implantation, previous surgery	adherences	implantation	gen	functioning (2 months)*

Time, months after PD start; Outcome, PD catheter function from time of intervention to March 2005; F, female; M, male; n.a., not applicable; gen., general anaesthetic; loc., local anaesthetic; →, conversion to; †, deceased; HD, haemodialysis.
°Reason not due to PD failure.
*Patient still on PD (time point end of March 2005).

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Minimal follow-up time of PD catheter function after videolaparoscopic rescue for malfunction was 5 months. Catheter function was prolonged by a median of 163 days (mean 440 days, range 5–1469 days), taking together first and second videolaparoscopic revisions and excluding patients who died under PD therapy during the follow-up. Three patients died between 66 and 480 days (median 270 days) after videolaparoscopic revision with a functioning PD catheter.

Figure 1 depicts catheter survival during the study period. The curve with open circles represents catheter survival on the assumption of catheter loss without performing VLS rescue therapy, in contrast to the curve with black points, which shows the effect of VLS rescue intervention on catheter survival at our centre. The third curve with open triangles evidences the survival of VLS rescued PD catheters. One year catheter survival on the assumption of catheter loss without VLS therapy is 71%. VLS intervention resulted in a significant increase of 1 year catheter survival to 80% ($P = 0.04$, Gehans' Wilcoxon test).

The only complication consisted in a case with leakage of the PD fluid due to insufficient closure of one mini-laparotomy access site (case 6). PD had to be suspended for 2 weeks.

Table 2. Indications for videolaparoscopic interventions (total 32 cases)

Indications	Cases/%
Malfunction of the PD catheter	21/65.6
Positioning of the PD catheter in patients with preceding laparotomy	8/25.0
Cholecystectomy	2/6.3
Abdominal occlusion	1/3.1

Discussion

Omental wrapping

The major cause of PD catheter malfunction was omental wrapping with a prevalence of 57% in our VLS series (Table 1), and incidence of 13.2% at our centre (Table 3). The incidence of this complication has been reported as high as 32% [8]. In seven of 12 cases, unwrapping of the omental tissue was performed. In two cases, the PD catheter had to be removed,

Table 3. Videolaparoscopic diagnosis in cases of PD catheter malfunction (total 21 cases), prevalence rates in the VLS series and incidence rates at our centre

Diagnosis	Prevalence rate Cases/%	Incidence rate* %
Wrapping by omental tissue	8/38.1	7.9
Wrapping by omental tissue and dislocation	3/14.3	4.0
Wrapping by omental tissue and thrombosis by peritubal tissue	1/4.8	1.3
Dislocation	5/23.8	4.0
Thrombosis due to intraperitoneal bleeding	1/4.8	1.3
Thrombosis due to fibrin clot	1/4.8	
Malpositioning between peritoneal and muscular fascia	1/4.8	1.3
Intestinal perforation and wrapping by omental tissue	1/4.8	

*The incidence rate does not take into consideration patients transferred to our centre from other centres. It is calculated on the basis of patients of our centre, as incidence rates may vary from centre to centre.

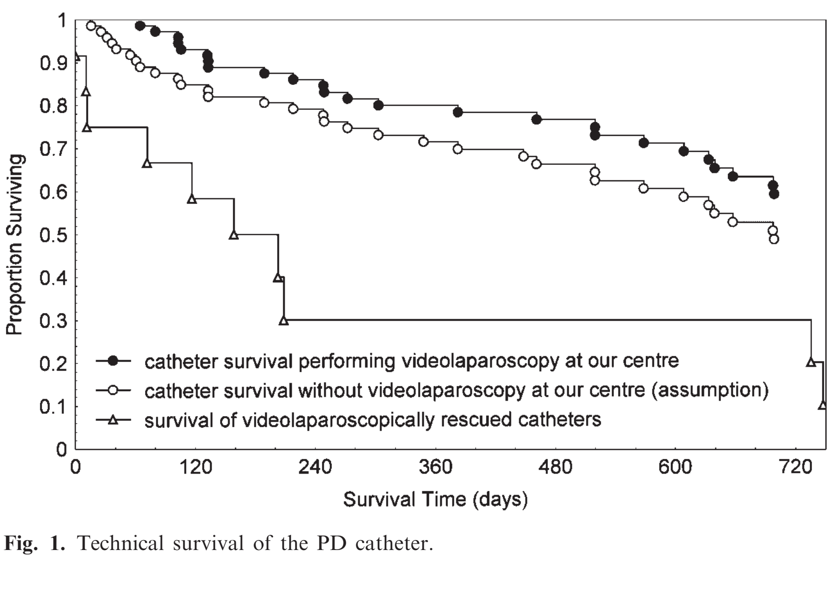

Fig. 1. Technical survival of the PD catheter.

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in the first case with return to haemodialysis (case 4) and in the second case with placement of a new PD catheter as wrapping occurred around the internal cuff, which had been erroneously positioned intraperitoneally (case 14).

Several relapses of omental wrapping occurred in four different patients. In the first patient in omentectomy of our series (case 1, 3 and 4) wrapping occurred despite fixation of the catheter in the lower pelvis. The catheter was removed after the second relapse, as technical experience at our centre was not present at that timepoint. In the other three patients we performed partial omentectomy, using an endoscopic linear cutter (case 16; Endopath ETS45, Ethicon Endo-Surgery, Cincinnatti, U.S.A.), a high frequency hook electrode (case 17) and an ultrasound cutter (case 30; Ultracision, Ethicon Endo-Surgery). The case 16 patient had a relapse-free long-term favourable outcome despite intercurrent laparoscopic cholecystectomy (case 19). The case 17 patient presented a relapse of omental wrapping together with dislocation after 5 months (case 18) necessitating stripping and fixation of the catheter. As dysfunction occurred again 2 months later the catheter was removed. The PD catheter of case 30 was well functioning during 5 months of follow-up.

The use of an ultrasound cutter abbreviated the intervention time for partial omentectomy, in contrast to endoscopic linear cutter and hook cautery. Laparoscopic procedures limited to liberate the catheter from omental tissue seem to be associated with a high rate of recurrent obstruction, indicating the necessity to perform preventive interventions [12,13]. Omentopexy [8] or omental epiplopexy [13] might be a valid alternative to omentectomy in these cases.

Dislocation, repositioning and fixation of the PD catheter

Only a minority of dislocations could be resolved by conservative procedures, in contrast to publications reporting success rates of more than 65% [14]. Non-responders were eligible for videolaparoscopic guided repositioning and fixation of the PD catheter (eight cases). Fixation of the PD catheter was performed in the first four patients, by attaching the PD catheter at the anterior wall of the pelvic cavity or in the case of postmenopausal patients, at the tubal-ovarian ligament by a knot. This procedure had a disadvantage necessitating a videolaparoscopic intervention in case of catheter removal as seen in case 4 and 13. Consecutively, the procedure was modified by bending the catheter to the anterior abdominal wall 3–4 cm below the intraperitoneal entrance site with a non-absorbable loop. The loop itself is fixed extraperitoneally by a subcutaneous knot. In this way, removal of the catheter can be performed without VLS, as the catheter needs only to be pulled out of the loop without untying the subcutaneous knot. A similar procedure has already been presented by other authors [7,15].

At our centre, the incidence of catheter dislocation necessitating VLS rescue therapy is 8%. A recent study compared dislocation rates of straight Tenckhoff catheters and self-locating catheters, describing a significant reduction of radiologically diagnosed dislocations from 12 to 0.8% for the latter catheter type. However, the rate of catheter malfunction caused by catheter dislocation was not specified in this publication [16]. An elegant alternative to prevent dislocation and omental wrapping without fixation of the catheter or manipulation of the omentum is the laparoscopic placement in a preperitoneal tunnel from the insertion site down to the level of the pubic symphysis as recently described in 12 patients [17].

Positioning of the PD catheter by VLS

Positioning of the PD catheter under videolaparoscopic control was restricted to patients with previous major abdominal interventions (cases 21–23, 26, 29, 31, 32) or to additional surgical interventions like cholecystectomy (case 7, patient with relapsing cholecystitis) and liver biopsy (case 26, patient with hepatitis C in order to perform staging for inclusion in an organ transplant program). Adhesiolysis had to be performed only in two of seven patients with previous abdominal interventions (case 23 and 26) in order to place the PD catheter correctly.

Up to now, the open surgical approach is the technique mainly used for catheter placement in Italy. Laparoscopic assisted placement of PD catheters is a viable alternative to the traditional surgical technique. Patients seem to benefit from less postoperative discomfort and an earlier return to full mobility. There might be a better long-term catheter survival and a lower incidence of catheter dysfunction in laparoscopically placed catheters in contrast to the open surgical technique [18,19]. In our opinion, the laparoscopic approach for placement of PD catheters is preferable in patients with a history of abdominal surgery or recurrent peritonitis from previous PD therapy [8,9]. Especially in these patients the laparoscopic technique reduces the risk of bowel and vascular injury. Moreover, VLS facilitates successful placement in the presence of intra-abdominal adhesions, in which PD catheter placement may be contraindicated. Up to now, there is insufficient data regarding long-term catheter survival after VLS placement in patients with previous surgery [20].

Intraluminal occlusion of the PD catheter

Despite Fogarty catheter manipulation, sufficient PD catheter function could not be restored in three patients. The occluding material consisted of erythrocyte-fibrin clots (case 12 with a haemorrhagic peritonitis by *Staphylococcus aureus* and case 13 with a spontaneous haematoperitoneum) and in peritubal tissue (case 24) blocking the exit holes of the catheter. Under videolaparoscopic control, the PD catheter

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was liberated intraluminally by inserting a ureteral catheter of 5 French, expelling the occluding material intraperitoneally. Forced flushing helped to liberate the exit holes completely. The instillation of urokinase, which is not performed at our centre for the conservative management of catheter malfunction, might avoid the need for VLS intervention in some cases [21]. Cases of PD catheter obstruction by peritubal tissue resolved by laparoscopic intervention have already been described by other authors [22].

Particular cases

Malpositioning between peritoneal and muscular fascia (Table1, Case 2)

Initiating the training for PD, 1 month after the insertion by open surgical technique, the PD catheter was completely occluded. The anteroposterior abdominal radiograph excluded dislocation to the upper abdomen. Fogarty catheter manipulation failed. VLS demonstrated an erroneous preperitoneal placement between the peritoneum and the posterior fascia of the anterior abdominal muscles. The peritoneum was cut with coagulating scissors liberating the PD catheter. The patient died with a functioning PD catheter 16 months later.

Intestinal perforation and omental wrapping (Table 1, Case 10)

On initiating PD the patient presented imperfect infusion and drainage of the dialysate. Three weeks later, there was an episode of diffuse abdominal peritonitis-like pain lasting for 1 day followed by a complete occlusion of the catheter. In VLS the catheter seemed to be wrapped by omental tissue attached at a small bowel loop. The catheter was liberated from the omentum making evident local fibrinous peritonitis and a small bowel perforation. The perforation was sutured extracting the bowel segment through one of the mini-laparatomy access sites. PD was successfully resumed 10 days after the videolaparoscopic intervention. A similar clinical experience had already been published out a patient with perforated appendicitis [23].

Pericatheter incisional hernia with small bowel strangulation (Table 1, Case 25)

Six months after the placement of the PD catheter the patient was hospitalized for intestinal occlusion. VLS demonstrated a strangulated necrotic small bowel loop of 10 cm length inside a hernia at the PD catheter site. Explorative laparoscopy was converted into open laparotomy with resection of the necrotic segment and configuration of a new end-to-end small bowel anastomosis. The patient continued on haemodialysis.

Several authors discuss the use of laparoscopy in cases of acute intestinal obstruction, however, exclusively in patients without peritoneal dialysis therapy. Laparoscopy seems to be a safe and effective alternative to laparotomy especially in the early time course of intestinal obstruction and in patients with previous abdominal surgery [24].

Catheter survival after videolaparoscopy

Technical survival of surgically placed, straight Tenckhoff catheters is in the range of 74–97% at 1 year [10,11,16,25]. A recent update of the recommendations of the International Society of Peritoneal Dialysis suggests a catheter survival of more than 80% at 1 year as a reasonable goal nowadays [18]. At our centre, 1 year catheter survival on the assumption of catheter loss without performing VLS rescue therapy, is 71% (Figure 1), thus at the lower range of published data. The reason for this is a high catheter malfunction rate of nearly 20%, mainly caused by omental wrapping and dislocation (Table 3). The use of VLS for rescue therapy resulted in a significant increase of 1 year catheter survival of up to 80%. Function of rescued catheters was prolonged by a median of 163 days (mean 440 days). A similar extension of catheter function was documented by Amerling *et al.* [12] in 28 VLS procedures for catheter malfunction with a median of 5–7 months (mean 9.2 months).

Conclusions

VLS has an important diagnostic and therapeutic role in the evaluation of malfunctioning catheters, as the cause of dysfunction can be directly assessed, functional rescue obtained and catheter life prolonged. In our 10-year experience, all cases of catheter dysfunction could be corrected by VLS.

We suggest immediate restart of the PD after VLS to prevent re-occlusion and formation of adhesions as blood and fibrin are rapidly cleared from the abdominal space. This has to be considered especially in cases in which limited intra-abdominal bleeding is present as in partial omentectomy. Furthermore, the approach with mini-laparotomies and purse-string sutures permits immediate resumption of PD after VLS, thus avoiding transient haemodialysis.

In this study, the use of VLS for placement of PD catheters was reserved for patients with previous laparotomies and for patients in whom additional abdominal interventions accessible for VLS had to be performed. In our series, erroneous insertion of the catheter could have been prevented in two patients using VLS. The question, whether catheter survival could have been improved by implanting all catheters under VLS control, cannot be answered.

Videolaparoscopic interventions for malfunction prolonged PD catheter function by about half a year despite frequent relapses. Fixation of the catheter at the anterior abdominal wall, omentectomy or omentopexy might reduce or even abolish relapses caused by wrapping and dislocation.

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In our opinion, the fundamental use of VLS should be the diagnosis and treatment of PD catheter malfunctions, which usually result in unnecessary removal or replacement of the catheter.

Placement of Tenckhoff catheters under videolaparoscopic control makes PD accessible to patients who have undergone prior abdominal operations.

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