VIDEOLAPAROSCOPIC CATHETER PLACEMENT REDUCES CONTRAINDICATIONS TO PERITONEAL DIALYSIS

Stefano Santarelli,¹ Matthias Zeiler,¹ Tania Monteburini,¹ Rosa Maria Agostinelli,¹ Rita Marinelli,¹ Giorgio Degano,² and Emilio Ceraudo²

Department of Nephrology¹ and Department of General Surgery,² Ospedale "Carlo Urbani," Jesi, Italy

◆ **Background:** Videolaparoscopy is considered the reference method for peritoneal catheter placement in patients with previous abdominal surgery. The placement procedure is usually performed with at least two access sites: one for the catheter and the second for the laparoscope. Here, we describe a new one-port laparoscopic procedure that uses only one abdominal access site in patients not eligible for laparotomic catheter placement.

◆ **Method:** We carried out one-port laparoscopic placement in 21 patients presenting contraindications to blind surgical procedures because of prior abdominal surgery. This technique consists in the creation of a single mini-laparotomy access through which laparoscopic procedures and placement are performed. The catheter, rectified by an introducer, is inserted inside the port. Subsequently, the port is removed, leaving the catheter in pelvic position. The port is reintroduced laterally to the catheter, confirming or correcting its position. Laparotomic placement was performed in a contemporary group of 32 patients without contraindications to blind placement. Complications and long-term catheter outcome in the two groups were evaluated.

◆ **Results:** Additional interventions during placement were necessary in 12 patients of the laparoscopy group compared with 5 patients of the laparotomy group ($p = 0.002$). Laparoscopy documented adhesions in 13 patients, with need for adhesiolysis in 6 patients. Each group had 1 intra-operative complication: leakage in the laparoscopy group, and intestinal perforation in the laparotomy group. During the 2-year follow-up period, laparoscopic revisions had to be performed in 6 patients of the laparoscopy group and in 5 patients of the laparotomy group ($p = 0.26$). The 1-year catheter survival was similar in both groups. Laparoscopy increased by 40% the number of patients eligible to receive peritoneal dialysis.

◆ **Conclusions:** Videolaparoscopy placement in patients not eligible for blind surgical procedures seems to be equivalent

to laparotomic placement with regard to complications and long-term catheter outcome. The number of patients able to receive peritoneal dialysis is substantially increased.

Perit Dial Int 2013; 33(4):372–378 www.PDIConnect.com
epub ahead of print: 03 Dec 2012 doi:10.3747/pdi.2011.00314

KEY WORDS: One-port placement; surgical placement; technical survival; videolaparoscopy; Tenckhoff catheter; adhesiolysis; contraindication.

Videolaparoscopy (VLS) is increasingly being considered the reference for peritoneal dialysis (PD) catheter rescue as well as for placement (1–3). Several VLS techniques for catheter placement have been developed. Most use at least two accesses to the abdominal cavity: one for the PD catheter and at least one for the VLS ports (4–9).

Laparoscopic techniques are at least equivalent to standard laparotomic placement procedures with regard to complications and outcomes (10–13), and they are especially indicated in patients with prior abdominal surgery (14,15).

Since 2007, we have applied one-port VLS placement procedures in patients with contraindications to standard laparotomic placement. Here, we describe this one-port technique and our evaluation of catheter outcome compared with catheters placed by laparotomy in patients without contraindications to open surgical technique.

METHODS

Between April 2007 and December 2010, 21 consecutive patients underwent one-port VLS-controlled catheter placement at our center in preparation for dialysis start. All patients had undergone previous major surgical interventions in the abdominal space and had been classified as not eligible for standard laparotomic catheter placement. The patients included those evaluated at our

Correspondence to: M. Zeiler, Unità Operativa di Nefrologia e Dialisi, Ospedale "Carlo Urbani," Via dei Colli n. 52, Jesi I-60035 Italy.

mrhz1@yahoo.com

Received 13 December 2011; accepted 8 May 2012

center and those referred from other regional hospitals in central Italy. The decision about whether the patient was eligible or not eligible for laparotomic catheter placement was taken by the nephrologist together with the surgeon, considering the number and the extent of previous interventions and potential complications, especially in the lower abdomen. A contemporary control group included 32 patients without clinical contraindications to laparotomic placement. Tables 1 and 2 summarize the characteristics of both patient groups.

All interventions were performed by a team composed of a surgeon and 1 or 2 nephrologists in the case of VLS-controlled placement or of 2 nephrologists or of 1 nephrologist and 1 surgeon in the case of standard surgical placement. Prophylactic antibiotic therapy consisted of 1 g vancomycin given intravenously before surgery. In all patients, straight double-cuffed Tenckhoff catheters from various manufacturers were used.

The peritoneal access consists of one mini-laparotomy site, 15 mm in diameter, about 2 – 4 cm inferior and

lateral (right or left) to the umbilicus. A purse-string suture around the peritoneal aperture is used to obtain tight closure without leakage at the end of the intervention.

In the case of VLS-controlled catheter placement, a laparoscopy port with diameter of 10 mm is inserted into the mini-laparotomy site. Pneumoperitoneum with carbon dioxide at a pressure of 12 mmHg is created, followed by exploration of the abdominal cavity using a videolaparoscope with operative channel [0-degree laparoscope, 10-mm shaft diameter, 5-mm operative channel (Karl Storz, Tuttlingen, Germany); Figure 1(A)]. Additional intra-abdominal interventions such as adhesiolysis and peritoneal biopsy are performed as necessary through the indicated access site. Adhesiolysis is performed through the operative channel of the laparoscope by applying simple traction with a grasping forceps and high-frequency electrosurgical dissection. To complete the placement procedure, the PD catheter is inserted inside the laparoscopy port directed to the pelvic cavity,

TABLE 1
Demographic and Placement Procedure Data for the Study Patients

Variable	Placement procedure		<i>p</i> Value
	One-port VLS	Standard surgical	
Patients [<i>n</i> (women/men)]	21 (14/9)	32 (7/25)	
Mean age (years)	65±16	63±18	0.76 ^a
With diabetes (<i>n</i>)	2	11	0.04 ^b
Mean follow-up (months)	25.6±13.9	24.9±11.6	0.90 ^a
Earlier abdominal interventions (<i>n</i>)			0.0001 ^b
None	0	19	
1	5	12	
2	10	1	
>2	6	0	
Anesthesia (<i>n</i>)			
Local	5	26	
Spinal	0	4	
General	16	2	
Additional interventions during placement (<i>n</i>)			0.002 ^b
Abdominal or inguinal hernioplasty	4 (2 inguinal, 2 abdominal wall)	4 (3 inguinal, 1 umbilical)	
Adhesiolysis	6	—	
Peritoneal biopsy	2	—	
Intestinal perforation repair	—	1 ^c	

VLS = videolaparoscopic.

^a By Mann–Whitney test.

^b By chi-square test.

^c Intra-operative complication.

TABLE 2
Data on Earlier Abdominal Interventions in the One-Port Videolaparoscopic-Controlled Placement Group

Earlier intervention	Adhesions present?	Adhesiolysis necessary?
Appendectomy (complicated by peritonitis)	Yes	No
Hemicolectomy	Yes	No
Hemicolectomy	Yes	Yes
Nephrectomy	No	—
Suprapubic transvesical prostatectomy	No	—
Appendectomy (complicated) + cholecystectomy (3 patients)	Yes	No
Appendectomy (complicated) + cesarean section	Yes	Yes
Appendectomy (complicated) + cesarean section	No	—
Appendectomy (complicated) + adnexectomy	Yes	No
Appendectomy + partial gastrectomy	Yes	No
Appendectomy + suprapubic transvesical prostatectomy	Yes	Yes
Cesarean section + hemicolectomy	Yes	Yes
Cesarean section + renal transplantation	No	—
Hysterectomy + appendectomy + nephrectomy	No	—
Hysterectomy + appendectomy + abdominal hernioplasty	No	—
Adnexectomy + appendectomy + cholecystectomy	Yes	Yes
Cholecystectomy + appendectomy (complicated) + partial gastrectomy	Yes	Yes
Cholecystectomy + renal transplantation + abdominal hernioplasty	No	—
Cholecystectomy + cesarean section + adnexectomy	No	—

and rectified using a Guyton introducer [Figure 1(B)]. Subsequently, the introducer and the port are removed, leaving the PD catheter in place downward with respect to the pelvis [Figure 1(C)]. The port is then reintroduced laterally to the PD catheter, and pneumoperitoneum is re-created to confirm or to correct the catheter position under laparoscopy [Figure 1(D)]. At the end of intervention, the pneumoperitoneum is completely released, the port is removed, and the purse-string suture is tightly closed below the internal cuff of the catheter. The catheter is embedded at a length of about 2 cm under the rectus muscle to maintain an oblique direction. A curved tunneler is used to create the exit site in a lateral, downward-oriented position.

In the case of laparotomic catheter placement, the PD catheter is inserted into the abdominal cavity and rectified using a Guyton introducer after a mini-laparotomy access with purse-string suture around the peritoneal aperture has been created. The introducer is then removed, leaving the PD catheter in the desired direction. Subsequently, the purse-string suture is tightly closed, and the catheter is embedded in the same manner as already described.

In both placement groups, catheter function is tested after the purse-string suture is tightened.

The two placement groups were compared with respect to patient characteristics, additional surgical interventions, complications during the first month

after catheter placement, and long-term technical catheter survival. Technical survival of the peritoneal catheter was estimated using the Kaplan–Meier method, with censoring for voluntary change to hemodialysis, kidney transplantation, and death with a functioning catheter. Differences in survival were analyzed using the Gehan–Wilcoxon test. The nonparametric tests used included the Mann–Whitney U-test for non-paired continuous values and the chi-square test for categorical variables. Statistical significance was considered at $p < 0.05$. The percentage of additional patients starting PD therapy because of the application of VLS placement was calculated based on the number of patients needing VLS for catheter placement divided by the number of patients eligible for standard surgical placement.

RESULTS

Follow-up after placement ranged between 3 months and 4 years, with a mean of about 2 years, which was similar in both groups.

All patients in the VLS group had a history of previous abdominal surgery, with most having undergone at least 2 preceding abdominal interventions; in contrast fewer than half the patients in the standard surgical group had such a history. The VLS placement group contained significantly more women (chi-square test: $p = 0.001$). Table 2 summarizes the previous abdominal surgeries in the one-port

Figure 1 — One-port videolaparoscopic-controlled peritoneal dialysis (PD) catheter placement procedure. (A) Insertion of the laparoscope through the port and exploration of the abdominal cavity (smaller frame). (B) Insertion of the PD catheter rectified by a Guyton introducer in the port with direction toward the pelvic cavity. (C) Removal of the laparoscopy port, leaving the PD catheter in position. (D) Reintroduction of the laparoscopy port laterally to the PD catheter, and videolaparoscopic control of the catheter position (smaller frame).

VLS-controlled placement group. Previous surgery in the standard laparotomic placement group included uncomplicated appendectomy and inguinal hernioplasty.

Additional surgical interventions during the catheter placement procedure were significantly more often necessary in the VLS-controlled placement group than in the laparotomy group. Adhesions were documented in 13 of 21 VLS patients (9 women, 3 men; Table 2), but to correctly place the catheter and to guarantee adequate function, adhesiolysis had to be performed in only 6 of the 13 patients (3 women, 3 men; Tables 1 and 2). At the end of the placement procedure, VLS control showed that a correction of the catheter position was necessary in 4 patients.

Additional surgical interventions prolonged the intervention time, defined as the presence of the patient in the operating theatre and the duration of the hospital stay.

In each group, 1 intra-operative complication occurred. Further complications during the first month after placement occurred in 5 patients in each group

(Table 3). Two cases of catheter malfunction because of dislocation—in 1 patient in each group—were resolved in a conservative manner by enema or by manipulation using a metal guide wire or a Fogarty catheter. Only 1 patient in each group needed surgical re-intervention. After the first month, VLS rescue procedures had to be undertaken in 5 patients in each group because of persistent catheter malfunction.

Probability of 1-year catheter survival was 85.2% in the VLS-controlled placement group and 77.6% in the standard laparotomy group; after 2 years, the probability was 73% in both groups. Technical survival of the peritoneal catheter did not differ between the groups (Gehan–Wilcoxon test: $p = 0.82$).

During the study period, 63 patients underwent PD catheter placement in the 4 major referring centers. Of those 63 patients, 18 were assessed as not being eligible for standard laparotomic placement. The other 45 had no contraindications to standard surgical placement. In the 18 “ineligible” cases, one-port VLS-controlled

TABLE 3
Data on Catheter Placement Procedure, Hospitalization, and Complications in the Study Group

Variable	Placement procedure		<i>p</i> Value
	One-port VLS	Standard surgical	
Mean duration of surgery [minutes (<i>n</i> pts)]			
Without additional intervention	45±12 (9)	47±12 (27)	0.97 ^a
With additional intervention	55±20 (12)	77±17 (5)	0.06 ^a
Mean duration of hospital stay ^b [days (<i>n</i> pts)]			
Without additional intervention	6±5 (9)	5±6 (27)	0.54 ^a
With additional intervention	4±1 (12)	8±6 (5)	0.08 ^a
Complications during postoperative month 1 ^c [<i>n</i> (management)]			0.46 ^d
Intestinal perforation	—	1 (intraoperative revision) ^e	
Leakage	1 leakage (conservative) ^e	—	
Hematoma/bleeding	1 intra-abdominal (conservative)	1 hematoma (conservative)	
Malfunction	1 dislocation (conservative)	1 dislocation (conservative)	
Infection	1 wrapping in adnexes (VLS revision) 1 fever (conservative)	2 exit-site infections (conservative)	
VLS interventions for catheter malfunction after postoperative month 1 (<i>n</i>)			0.46 ^d
Omental wrapping	3	3	
Dislocation	—	1	
Dislocation and omental wrapping	—	1	
Adhesions	2 (1 bowel-bowel, 1 bowel-abdominal wall)	—	

VLS = videolaparoscopic; pts = patients.

^a By Mann-Whitney test.

^b Includes day of surgical intervention.

^c Includes intra-operative complications.

^d By chi-square test.

^e Intra-operative complication.

placement was performed at our center. The application of VLS for catheter placement increased the number of patients able to begin PD by 18 patients, equivalent to an increase of 40%.

From a retrospective viewpoint, 8 patients in the VLS group [38.1% (6 patients needing adhesiolysis and 2 patients undergoing peritoneal biopsy)] attained a real benefit from VLS. Recalculated on the basis of the 4 major referring centers, the real benefit of videolaparoscopy was 12.5%, corresponding to 7 patients benefiting from VLS catheter placement in contrast to 56 patients not receiving such a benefit.

DISCUSSION

We applied a novel technique that uses only one peritoneal access for all procedures (VLS, simple

intra-abdominal interventions, PD catheter placement, and control of the PD catheter position) in patients assessed as not eligible for laparotomic catheter placement. Previous surgery by itself is not a contraindication to PD, but might be a contraindication to blind catheter placement techniques because of a high probability of placement failure and the risk of bowel lesions. Laparotomic placement permits direct confirmation only of access to the peritoneal cavity; intra-abdominal VLS exploration confirms the presence, localization, and extent of adhesions.

Our one-port technique avoids multiple peritoneal access sites and blind puncture of the abdominal cavity, thereby reducing the risk of leaks, intestinal perforation, and possibly even intra-abdominal residual scarring. To our knowledge, only three publications have described a single peritoneal access site for PD catheter placement

and VLS (16–18). Leung *et al.* (16) described 2 cases of PD catheter placement throughout the VLS access in a blind manner, without subsequent control of the catheter position. Yan *et al.* (17) applied VLS exploration of the abdomen through a 16 French peel-away sheath used subsequently for PD catheter placement in 18 patients. Mettang *et al.* (18) reported 2 separate interventions using a special PD catheter with an enlarged inner diameter: in one case, the PD catheter was inserted alongside the trocar under VLS control; and in the second case, the PD catheter, having been passed over a video bronchoscope 2.8-mm thick, was inserted in the trocar, thus controlling its position. Our procedure is similar to the first intervention described by Mettang and colleagues, but differs in the type of PD catheters used, the presence of a purse string suture, and the absence of break-in time before PD start.

In contrast to the three foregoing investigations, we preferred to create a mini-laparotomy access site with a purse-string suture to reduce the risk of leakage and to immediately use the catheter if necessary. The VLS control available during the placement procedure seems to be useful, because about 19% of catheters needed modification of position. All other so-called one-port PD catheter placement procedures used at least two peritoneal access sites, one for the PD catheter, and a second for the VLS port or instruments.

The VLS-controlled one-port technique seems to be equivalent to standard surgical placement with regard to complications and long-term catheter outcomes, even in patients with previous abdominal interventions. That finding accords with results in larger earlier studies and a meta-analysis comparing laparotomic and laparoscopic placement in adults (10–12). Only one study showed a lower number of leaks and exit-site infections and a higher catheter survival rate in the VLS placement group (13).

The presence of earlier surgical interventions and of intra-abdominal adhesions seems not to have had an impact on technical catheter survival. Two previous studies confirmed that prior abdominal surgery does not negatively affect technical catheter survival (14,15). Only patients in which adhesiolysis had to be performed showed a higher probability of catheter obstruction and a tendency toward lower technical survival (14). In our study, all patients in the VLS placement group and fewer than half the patients in the laparotomic placement group (40.6%) had a history of abdominal surgery. Most patients (61.9%) in the VLS group had adhesions, but not quite half (46.2%) of them needed adhesiolysis. A survival analysis of the patients needing adhesiolysis was not performed because of a statistically insufficient

number of cases. Only 1 of these 6 patients needed VLS revision during the follow-up period.

Patients with several previous abdominal interventions should not be excluded from PD therapy, but should be admitted to centers experienced in VLS placement of PD catheters. It was for that reason that 43% of the patients in our VLS group had been referred from other centers.

We used only basic laparoscopic techniques, including exploration of the abdominal cavity and adhesiolysis to complete the placement procedure. Basic VLS does not significantly improve catheter outcome, but increases the number of patients that can be placed on PD. In this way, we were able to increase by 40% the number of patients who could use PD therapy—patients who would otherwise have been switched to hemodialysis in spite of a decision in favor of PD.

Given that the presence of adhesions cannot be predicted by a mere history of earlier abdominal interventions, and given also that the number of interventions increases the percentage of patients requiring adhesiolysis (14), it is difficult to foresee the real necessity of VLS surgery at catheter placement. Taking a retrospective viewpoint, only about 38% of the patients in the VLS group, corresponding to 1 of 8 patients (12.5%), benefited from that technique during the observation period. In contrast, none of the patients in the standard laparotomic group would have received a benefit from a primary VLS approach.

To be able to compare the outcome of our one-port VLS-controlled placement strategy with standard laparotomic catheter placement, we avoided using advanced laparoscopic techniques such as rectus sheath tunneling or omentopexy. For that reason, omental wrapping was the major cause of malfunction at laparoscopic revision of the catheters in both groups.

In children, the laparoscopic single-port approach uses two peritoneal access sites: one in a supra-umbilical position for the VLS port, and the second in a peri- or infra-umbilical position for the peritoneal catheter (19,20). Omentectomy and visual control of the catheter placement procedure are performed through the VLS access.

Mattioli *et al.* compared VLS results with a historical standard surgical group having a similar rate of prior surgery and demonstrated a lower rate of infections and leakage in the VLS group and similar rates of malfunction and necessity for surgical revision (20).

The present study has some limitations. It is not a blinded and randomized study of PD catheter outcome in a comparison of different placement procedures. Strict internal guidelines about the technique to be used in placing PD catheters in the case of prior abdominal

surgery were not applied, and the team's decision was taken in an opinion-based manner. The number of patients in the two groups was small, thus limiting the potential for subgroup analysis.

In the case of one-port VLS-controlled placement as described, certain technical consideration should be kept in mind. The port has to be inserted and removed twice during the placement procedure. The surgical team should take care not to destabilize or lacerate the purse-string suture. Such an event was probably the cause of the leak seen in one of the patients.

Single-port laparoscopic surgery is a refinement of standard multi-incision laparoscopic surgery to reduce surgical trauma. The present study is the first with a larger number of patients to apply that concept for the placement of PD catheters in patients classified as not eligible for standard laparotomic placement.

ACKNOWLEDGMENTS

We are grateful to the dialysis centers of Città di Castello, Fabriano, Assisi, Ancona, Pesaro, and Urbino—all from central Italy—for their cooperation. We are indebted to the nursing staff of the nephrology department (Cinzia Casci, Antonella Fraboni, Laura Galeassi, Stefania Picciaiola, and Lorena Sbarbati) and the operating room for their assistance. We thank Maurizio Paradisi for his help with the photographic work.

DISCLOSURES

No author had any involvement that might raise a question of bias in the work reported here, or in the conclusions, implications, or opinions stated.

REFERENCES

1. Giannattasio M, La Rosa R, Balestrazzi A. How can video-laparoscopy be used in a peritoneal dialysis programme? *Nephrol Dial Transplant* 1999; 14:409–11.
2. Crabtree JH, Fishman A. A laparoscopic method for optimal peritoneal dialysis access. *Am Surg* 2005; 71:135–43.
3. Santarelli S, Zeiler M, Marinelli R, Monteburini T, Federico A, Ceraudo E. Videolaparoscopy as rescue therapy and placement of peritoneal dialysis catheters: a thirty-two case single centre experience. *Nephrol Dial Transplant* 2006; 21:1348–54.
4. Nijhuis PH, Smulders JF, Jakimowicz JJ. Laparoscopic introduction of a continuous ambulatory peritoneal dialysis (CAPD) catheter by a two-puncture technique. *Surg Endosc* 1996; 10:676–9.
5. Watson DI, Paterson D, Bannister K. Secure placement of peritoneal dialysis catheters using a laparoscopic technique. *Surg Laparosc Endosc* 1996; 6:35–7.
6. Wang JY, Hsieh JS, Chen FM, Chuan CH, Chan HM, Huang TJ. Secure placement of continuous ambulatory peritoneal dialysis catheters under laparoscopic assistance. *Am Surg* 1999; 65:247–9.
7. Comert M, Borazan A, Kulah E, Uçan BH. A new laparoscopic technique for the placement of a permanent peritoneal dialysis catheter: the preperitoneal tunneling method. *Surg Endosc* 2005; 19:245–8.
8. Carrillo SA, Gherzi MM, Unger SW. Laparoscopic-assisted peritoneal dialysis catheter placement: a microinvasive technique. *Surg Endosc* 2007; 21:825–9.
9. Maio R, Figueiredo N, Costa P. Laparoscopic placement of Tenckhoff catheters for peritoneal dialysis: a safe, effective, and reproducible procedure. *Perit Dial Int* 2008; 28:170–3.
10. Wright MJ, Bel'eed K, Johnson BF, Eadington DW, Sellars L, Farr MJ. Randomized prospective comparison of laparoscopic and open peritoneal dialysis catheter insertion. *Perit Dial Int* 1999; 19:372–5.
11. Soontrapornchai P, Simapatanapong T. Comparison of open and laparoscopic secure placement of peritoneal dialysis catheters. *Surg Endosc* 2005; 19:137–9.
12. Strippoli GF, Tong A, Johnson D, Schena FP, Craig JC. Catheter-related interventions to prevent peritonitis in peritoneal dialysis: a systematic review of randomized, controlled trials. *J Am Soc Nephrol* 2004; 15:2735–46.
13. Gadallah MF, Pervez A, el-Shahawy MA, Sorrells D, Zibari G, McDonald J, *et al.* Peritoneoscopic versus surgical placement of peritoneal dialysis catheters: a prospective randomized study on outcome. *Am J Kidney Dis* 1999; 33:118–22.
14. Crabtree JH, Burchette RJ. Effect of prior abdominal surgery, peritonitis, and adhesions on catheter function and long-term outcome on peritoneal dialysis. *Am Surg* 2009; 75:140–7.
15. Keshvari A, Fazeli MS, Meysamie A, Seifi S, Taromloo MK. The effects of previous abdominal operations and intraperitoneal adhesions on the outcome of peritoneal dialysis catheters. *Perit Dial Int* 2010; 30:41–5.
16. Leung LC, Yiu MK, Man CW, Chan WH, Lee KW, Lau KW. Laparoscopic management of Tenckhoff catheters in continuous ambulatory peritoneal dialysis. A one-port technique. *Surg Endosc* 1998; 12:891–3.
17. Yan X, Zhu W, Jiang CM, Huang HF, Zhang M, Guo HQ. Clinical application of one-port laparoscopic placement of peritoneal dialysis catheters. *Scand J Urol Nephrol* 2010; 44:341–4.
18. Mettang T, Krumme B, Wilhelm A, Duschka L. Endoscopic transluminal insertion of a peritoneal dialysis catheter. *Perit Dial Int* 2010; 30:63–5.
19. Milliken I, Fitzpatrick M, Subramaniam R. Single-port laparoscopic insertion of peritoneal dialysis catheters in children. *J Pediatr Urol* 2006; 2:308–11.
20. Mattioli G, Castagnetti M, Verrina E, Trivelli A, Torre M, Jasonni V, *et al.* Laparoscopic-assisted peritoneal dialysis catheter implantation in pediatric patients. *Urology* 2007; 69:1185–9.