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Perioperative Management of Continuous Ambulatory Peritoneal Dialysis Patients Undergoing Inguinal Hernia Surgery

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Abstract
Management of patients undergoing dialysis after inguinal hernia surgery has not been standardized. This report presents the results of 9 patients with inguinal hernias (11 hernias) who were undergoing continuous ambulatory peritoneal dialysis (CAPD). All patients treated in this hospital since 2007 have returned to CAPD within 3 days after surgery without switching to hemodialysis (HD). The mean durations for resuming CAPD after surgery were 7.6 days from 1998 through 2007 and 2.3 days since 2008. The surgical procedure was performed with a polypropylene mesh in all cases. Local anesthesia was utilized for one patient with low cardiac function. All patients recovered rapidly, with no uremia or dialysis-related complications. No leakage or hernia recurrence was observed over the subsequent observation period (56.2 months). This experience suggests the possibility that interim HD can therefore be skipped in patients undergoing CAPD if the hernia sacs are closed tightly. Local anesthesia seems to be safe for high-risk hernia patients undergoing CAPD.

Key words Inguinal hernia · Continuous ambulatory peritoneal dialysis · Tension-free repair

This study retrospectively studied a series of 9 patients (11 hernias) on continuous ambulatory peritoneal dialysis (CAPD) who underwent reinforcement repair of an inguinal hernia from 1998 to 2008. Their characteristics and CAPD regimens are shown in Table 1. The average age of the patient population was 55.4 years (range, 36–75 years). The original disease was chronic glomerulonephritis (8 patients) and diabetes mellitus nephropathy (1 patient). The average duration on CAPD prior to developing the inguinal hernia was 19.2 months (range, 0–59 months). The patients treated from 1998 to 2007 usually waited 6–9 days, with bridging hemodialysis (HD), before resuming CAPD. All patients treated since 2008 have returned to CAPD within 2–3 days after surgery, with low volume (1.0–1.5 l) and high frequency (4–6 daily) exchanges without switching to HD. The mean duration for resuming CAPD after surgery were 7.6 days (range, 6–9 days) from 1998 through 2007 and 2.3 days (range, 2–3 days) since 2008. The mean duration for resuming the preoperative CAPD prescription after surgery was 7.9 days (range, 2–17 days). The diagnoses, surgical procedures, and types of anesthesia are shown in Table 2. There were 10 indirect hernias and 1 direct inguinal hernia. The surgical procedure was performed following the tension-free principles of hernia surgery by insertion of a polypropylene mesh in every case. Marcy and onlay mesh repair were carried out for nine hernias. Plug and onlay mesh repair were carried out for two hernias. The hernia sacs were simply inverted in the abdominal cavity whenever possible. Open hernia sacs were closed tightly with a running suture or a transfixing suture. General ($n = 6$) and spinal ($n = 2$) anesthesia was utilized for most patients. Local anesthesia was utilized for one patient because of low cardiac function.

All patients recovered rapidly, with no uremia or dialysis-related complications. No fluid leakage was found in the subsequent observation period (56.2 months; range, 10–134 months). There were no long-term complications (infection or recurrence) related to the polypropylene mesh.

Patients undergoing CAPD are at increased risk of developing inguinal hernias, with a reported prevalence of 4%–14%,[1–3] but management of dialysis after hernia surgery has not been standardized.[4] Increased intra-abdominal pressure from the peritoneal dialysate is thought to be a major risk factor for the development and recurrence of inguinal hernias. Intra-abdominal pressure measured at the inguinal level would be

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Table 1. Characteristics and continuous ambulatory peritoneal dialysis (CAPD) regimens of the patients

Case	Age (years)/sex	Etiology	Anticoagulant therapy	Duration of peritoneal dialysis (months)	Interim HD	Resumption of CAPD (POD)	Condition	Preoperative CAPD condition (POD)
1	58/M	CGN	–	0	+	7	Unknown	Unknown
				0	+	8		
2	51/M	CGN	+	59	+	5	3 × 2.5 l	5
3	51/M	CGN	+	25	+	9	2 × 1.5 l	9
4	75/M	DMN	+	31	+	9	2.0 l APD	9
5	69/M	CGN	+	55	+	8	1.5 l APD	8
6	36/M	CGN	–	8	+	6	2 × 1.5 l	6
7	42/F	CGN	–	2	–	2	6 × 1.0 l	7
8	72/M	CGN	+	3	–	2	4 × 1.5 l	2
9	45/F	CGN	–	3	–	3	4 × 1.0 l	17

HD, hemodialysis; POD, postoperative day; CGN, chronic glomerulonephritis; DMN, diabetes mellitus nephropathy; APD, automated peritoneal dialysis

Table 2. Diagnoses, surgical procedures, and type of anesthesia

Case	Type of hernia	Operation	Anesthesia	Sac open	Follow-up (months)
1	Lt. indirect	Marcy & onlay	Spine	–	134
	Rt. indirect	Marcy & onlay	Spine	–	134
2	Rt. indirect	Plug & onlay	Spine	–	60
3	Rt. indirect	Marcy & onlay	General	–	54
	Lt. indirect	Marcy & onlay		–	54
4	Rt. indirect	Marcy & onlay	General	+	49
5	Rt. indirect	Marcy & onlay	General	+	48
6	Rt. indirect	Marcy & onlay	General	+	40
7	Lt. indirect	Marcy & onlay	General	–	19
8	Rt. direct	Plug & onlay	Local	–	16
9	Rt. indirect	Marcy & onlay	General	+	10

approximately 30 cm higher than that at the xiphoid in the vertical position, thus resulting in 38–40 cm of water pressure with a 2-l intra-abdominal dialysate.[5] Dejardin et al.[6] reported that mean intra-abdominal pressure was 13.5 ± 3.3 cmH_2O for 2 l of intake at baseline. Twardowski et al.[7] demonstrated that the mean intra-abdominal pressure increased by 2.0, 2.7, and 2.8 cmH_2O per liter of intra-abdominal volume in the supine, upright, and sitting positions, respectively. Cobb et al.[8] reported that coughing and jumping generated the highest intra-abdominal pressure (146.3 cmH_2O and 232.6 cmH_2O, respectively) in healthy adults. Polypropylene mesh hernia repair is considered to be standard among patients undergoing CAPD because of the low recurrence rate.[9] More recently, a new type of lightweight, large porous mesh has been used for inguinal hernioplasty to reduce postoperative chronic pain. Ultrapro* mesh (Ethicon, Somerville, NJ, USA) is a partially absorbed mesh composed of poliglecaprone (absorbable) and polypropylene.[10] The burst pressure of a polypropylene mesh and Ultrapro* mesh in the stamp pressure test are 2216.8 cmH_2O and 884 cmH_2O, respectively.[11] The repair by Ultrapro* mesh is strong enough that the highest intra-abdominal pressure caused by coughing or jumping in inguinal hernia patients on CAPD might do no harm. This partially absorbable mesh will be used for inguinal hernia patients on CAPD in the future.

Peritoneal dialysis (PD) treatment was previously withheld for several days or even weeks to guarantee proper healing with the avoidance of early hernia recurrence and/or postoperative leakage. This was a significant disadvantage to patients, because it required a transfer to HD with institution of vascular access. This procedure frequently prolonged the hospital stay. Furthermore, insertion and maintenance of an indwelling HD catheter was itself associated with risk. Phagocytic cells, such as blood monocytes and tissue-derived macrophages, form granulomas at the interface of the implanted mesh as a foreign body reaction, and the implanted mesh adheres to the surrounding tissue within a few days after surgery. Considering this process, it is possible to promptly resume CAPD for patients after inguinal hernia surgery without interim HD and resume the preoperative CAPD prescription a week or two earlier than with the previously reported protocol.[4]

One of the patients in the current series had a low cardiac function due to heart valvular disease and had to undergo surgery with local anesthesia, and 4 out of 9 patients received anticoagulant therapy. Despite recent advances, the main cause of mortality in patients with end-stage renal disease undergoing PD or HD is cardiovascular disease.[12] Local anesthesia facilitates the operation in patients who are contraindicated to undergo general or spinal anesthesia.

Although the number of patients is limited, the results of this study suggest the possibility that perioperative HD can be skipped in CAPD patients undergoing inguinal hernia surgery and resume preoperative CAPD conditions in a week or two, as long as the hernia sacs are closed carefully. There were no long-term complications (infection or recurrence) related to the polypropylene mesh. A new type of lightweight, large porous mesh will be introduced for inguinal hernia repair in patients undergoing CAPD in the future. Local anesthesia seems to be safe for high-risk patients undergoing CAPD in whom a contraindication to general or spinal anesthesia may exist.

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