

# Monitored anesthesia care based on ultrasound-guided subcostal transversus abdominis plane block for continuous ambulatory peritoneal dialysis catheter surgery: case series

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**Abstract** Planning safe perioperative management for patients undergoing continuous ambulatory peritoneal dialysis (CAPD) catheter surgery (insertion and extraction of the catheter) is often difficult because many of these patients not only have renal insufficiency but also have co-existing disorders, such as heart diseases. As increased indications for perioperative anticoagulation therapy have limited the choice of anesthesia, selecting an appropriate anesthetic method, particularly for patients with poor systemic conditions, is becoming more challenging. We report seven cases of CAPD catheter surgery successfully managed by monitored anesthesia care using subcostal transversus abdominis plane (TAP) block with additional local anesthetic infiltration and analgesics. Despite co-existing cardiac disease and/or coagulation disorders, all patients were safely managed without any other major anesthetic methods. Subcostal TAP block is a useful anesthetic option for CAPD catheter surgery, particularly for patients with poor systemic conditions and/or in whom neuraxial blocks are contraindicated.

**Keywords** Transversus abdominis plane block · Continuous ambulatory peritoneal dialysis catheter surgery · Heart failure · Coagulation disorder

## Introduction

Planning safe and effective perioperative management for patients undergoing continuous ambulatory peritoneal dialysis (CAPD) catheter surgery (insertion and extraction of the catheter) is often difficult because many of these patients not only have renal insufficiency but also have poor systemic condition due to co-existing disorders, such as heart diseases. As the number of patients undergoing elective surgeries without discontinuing anticoagulation therapy has been increasing, neuraxial blocks, such as epidural and spinal anesthesia, have become less popular due to the possibility of serious neurological complications. Limited anesthetic choice makes the planning of anesthetic management for these patients more difficult. Here we report seven cases of CAPD catheter surgery successfully managed despite poor cardiac function and/or blood coagulation disorders. We provided monitored anesthesia care (MAC) [1] using ultrasound-guided subcostal transversus abdominis plane (TAP) block [2] and intraoperative additional analgesics when necessary. We describe one case in detail and present a summary of all cases. Written consent for publication was obtained from each patient.

## Case description

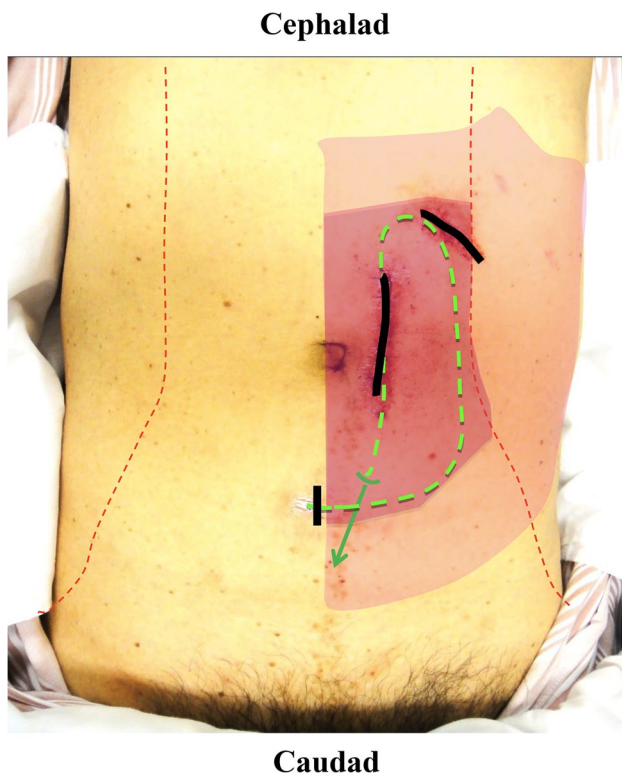
### Case 1

A male patient in his 50s with hypertensive nephrosclerosis was scheduled for CAPD. His past history included cerebellar infarction for which he was prescribed clopidogrel. Additionally, his cardiac function was very poor due to dilated cardiomyopathy. Preoperative cardiac ultrasound

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**Fig. 1** Postoperative photograph for case 1. The catheter was inserted subcutaneously along the *oval-shaped green broken line*. The *green arrow* shows the direction of which the catheter was inserted into the peritoneal cavity. Incision locations are shown by the *solid black lines*. The *colored area* shows expected analgesic area obtained by unilateral subcostal TAP block considered from anatomical and local anesthetic spread findings [6, 7]. The *dark-colored area* shows where complete analgesia can be obtained through the abdominal wall. The *light-colored area* shows where analgesia can be incomplete. On the lateral *light-colored area*, the outer half of the abdominal wall may remain unblocked. On the rest of the *light-colored area*, cranial and/or caudal analgesia depends on the spread of local anesthetic. *Red fine broken lines* are simulated borders between areas innervated by anterior cutaneous branches and those by lateral cutaneous branches (color figure online)

examination revealed hypokinetic left ventricular wall motion with an ejection fraction of 24 %, and his serum brain natriuretic peptide value was high (2189 pg/ml). CAPD catheter placement under epidural anesthesia after discontinuation of clopidogrel for 2 weeks was scheduled. However, it was found that the patient had continued oral clopidogrel by the day before surgery, necessitating anesthetic re-planning. Considering that the administration of general anesthesia could worsen his heart failure, we decided to provide MAC based on ultrasound-guided TAP block.

After confirming the planned incision site with the surgeon (Fig. 1), we elected to perform left subcostal TAP block to obtain the anterolateral analgesic area around the umbilicus. The patient was placed in the supine position

and sedated with 1 mg midazolam and 50  $\mu$ g fentanyl, both administered intravenously (IV). Using a sterile technique, a 13–6 MHz linear array probe (S-Nerve, Sonosite Inc., Bothell, WA, USA) was placed on the subcostal abdominal wall. The puncture site was infiltrated with 1 % mepivacaine, and a 22-G 100-mm needle (Sonorect needle<sup>®</sup>, CCR, Hakko, Japan) was advanced parallel to the costal arch using an in-plane technique under real-time ultrasound sonography. Local anesthetic (LA) was injected on the TAP just lateral to the rectus abdominis muscle followed by an additional injection on the TAP along the subcostal oblique line to obtain a hydro-dissected area wide enough for operation. A total of 36 ml of 0.375 % ropivacaine was injected on the TAP. After confirming the loss of cold sensation on the medial anterior abdominal wall, 1 mg midazolam and 50  $\mu$ g fentanyl were added IV for sedation. He was informed that he may be assisted with additional analgesics whenever necessary and surgery was initiated. When the patient complained of abdominal wall pain, but in a small area, local infiltration of lidocaine and intravenous 50  $\mu$ g fentanyl were provided. When the catheter was inserted into the abdominal cavity, the patient complained of abdominal discomfort, which was easily treated by intravenous 50  $\mu$ g fentanyl. The total dose of each anesthetic was 135 mg ropivacaine, 60 mg lidocaine, 2 mg midazolam, and 200  $\mu$ g fentanyl. He did not complain of unbearable pain or cardiac symptoms during surgery. His intraoperative hemodynamics were stable.

After surgery, although no pain score was recorded, the patient experienced little pain and required no additional analgesics.

Cases 2–7 were also successfully managed in a similar manner. Summaries of all cases are provided in Table 1. There were no anesthesia-related complications, such as LA intoxication, intra-abdominal organ injury, or postoperative neurological disturbances in any patient.

## Discussion

Subcostal TAP block is a technique used to alleviate somatic pain in the anterior abdominal wall by anesthetizing the anterior rami of the spinal nerves that run on the TAP. Because the technique cannot eliminate visceral pain, additional analgesic techniques are required for intraoperative and postoperative pain management in major abdominal surgeries. Therefore, reports on this block have been limited to those of intraoperative analgesia combined with general anesthesia or postoperative pain management combined with other analgesic techniques [3]. To the best of our knowledge, only two reports have been published on intraoperative abdominal pain management using TAP block without general anesthesia [4, 5].

**Table 1** Characteristics and anesthetic summaries of all cases

Case	Age (years)	Gender	Height (cm)	Weight (kg)	Type of surgery	ASA PS	Preoperative co-existing disorders except for renal insufficiency		
							Related to blood coagulation	Related to cardiac function	Others
1	50s	Male	169	60.0	I	3	Oral clopidogrel and icosapentate	Dilated cardiomyopathy	Hypertension, cerebellar infarction
2	80s	Male	162	55.0	I	3	Oral warfarin and aspirin	Chronic heart failure, AR, MR, Af, left ventricle: diffuse hypokinesis	SLE, RA, APS, cerebral infarction, smoking
3	60s	Male	162	56.6	I	3	Oral warfarin	Post CABG, chronic heart failure, left ventricle: partial akinesis	Hypertension, diabetes mellitus
4	80s	Male	162	51.4	E	3	Oral warfarin and aspirin	Chronic heart failure, AR, MR, Af, left ventricle: diffuse hypokinesis	SLE, RA, APS, cerebral infarction, smoking
5	60s	Male	162	54.0	E	3	Oral warfarin and aspirin, thrombocytopenia	Post CABG, chronic heart failure, left ventricle: partial akinesis	Hypertension, diabetes mellitus, pyrogenic spondylitis
6	60s	Female	145	38.0	E	3	Oral icosapentate	Not disturbed	Hypertension, hyperlipidemia
7	60s	Female	137	43.1	I	2	Oral dipyridamole	Not disturbed	Hypertension, hyperlipidemia
Case	Local anesthetic used for subcostal TAP block (Ropivacaine)				Intraoperative additional anesthetic				
	Side blocked	Conc. (%)	Vol. (ml)	Dose (mg)	Local anesthetic (lidocaine)			Fentanyl (µg)	Midazolam (mg)
					Conc. (%)	Vol. (ml)	Dose (mg)		
1	Left	0.375	36	135	1	6	60	100	1
2	Left	0.375	30	113	1	7.2	72	50	1
3	Left	0.375	40	150	1	24	240	75	1
4	Left Right	0.375 0.375	20 20	150	–	0	0	50	1
5	Left	0.375	40	150	1	14	140	50	0.5
6	Left	0.375	35	131	1	5	50	100	1
7	Left	0.375	27	101	1	2	20	50	0

Each patient received 1 mg midazolam and 50 µg fentanyl intravenously before anesthesia. Each patient received ropivacaine for subcostal TAP block and lidocaine for additional infiltration during surgery. Details of case 1 are described in the text. The patients in cases 2 and 3 are identical to that in cases 4 and 5, respectively

*I/E* insertion/extraction of catheter, *ASA PS* American Society of Anesthesiologist Physical Status, *CABG* coronary artery bypass graft, *AR* aortic valve regurgitation, *MR* mitral valve regurgitation, *Af* atrial fibrillation, *SLE* systemic lupus erythematosus, *RA* rheumatoid arthritis, *APS* antiphospholipid antibody syndrome, *TAP* transversus abdominis plane, *Conc.* concentration, *Vol.* volume

An additional reason for further analgesic requirements stems from the limited analgesic area obtained by subcostal TAP block. Unilateral subcostal TAP block with 20-ml injectate usually covers only three to four spinal nerves on

the TAP from the 9th to the 12th thoracic spinal nerves [6]. Furthermore, their lateral cutaneous branches (LCBs) are barely involved, as the spread of LA shown by magnetic resonance imaging [7] rarely extends laterally over the

mid-axillary line where LCBs diverge. Failure to involve LCBs leads to unsatisfactory analgesia in the outer half of the anterolateral abdominal wall involving the skin, subcutaneous tissue, and external oblique muscles. This explains the block of skin sensation on the anteromedial abdominal wall but not on the lateral area [2, 8]. The expected analgesic area obtained using unilateral subcostal TAP block based on these considerations is shown in Fig. 1.

In our cases, unilateral subcostal TAP block in combination with additional LA infiltration and analgesics provided effective analgesia because the main surgical site was limited to the left medial area surrounding the umbilicus (Fig. 1). Additional LA infiltrations were required in small areas on the superficial layer of the anterolateral abdominal wall considered to be innervated by LCBs and the opposite (unblocked) side of the abdominal wall. Although a few patients complained of momentary pain when the catheter was inserted into the abdominal cavity, it was considered as visceral and easily treated with intravenous 50 µg of fentanyl.

CAPD catheter surgery can be managed by general anesthesia, spinal or epidural anesthesia, and LA infiltration, depending on the patient's request and condition. General and neuraxial anesthesia can have a large effect on hemodynamics and complicate anesthetic management because patients who undergo CAPD catheterization often have poor cardiopulmonary function. Moreover, neuraxial anesthesia is contraindicated for those receiving anticoagulant therapy and/or with blood coagulation disorders. Surgery under LA infiltration alone may impose more frequent pain than other anesthetic measures.

Subcostal TAP block is considered to cause minimum hemodynamic changes with little sympathetic nerve block [7, 8]. Neurological complications are also expected to be minimum, and intra-abdominal organ injury can be prevented under ultrasound guidance [9]. Although TAP block may cause abdominal wall bleeding, the risk of its occurrence is similar to that associated with LA infiltration or the surgical procedure itself. According to the American College of Chest Physicians' evidence-based clinical practice guidelines [10], patients who require dermatologic procedures are recommended to continue their long-term antithrombotic therapy, with the exception of clopidogrel, which requires discontinuation for at least 5 days in cases with less risk of cardiac events. In our cases, CAPD catheter surgery and subcostal TAP block were as minimally invasive as dermatologic procedures. Although clopidogrel was not discontinued in case 1, we did not encounter complications. However, more attention to the risk–benefit balance was required for case 1 as a few reports have described massive bleeding in such cases [9].

Ultrasound-guided peripheral abdominal nerve blocks, such as TAP (lateral [7] and subcostal) and rectus sheath

blocks [11], are relatively safe and effective methods for anesthetizing the anterior abdominal wall not only in high-risk patients but also in patients without complications. Therefore, TAP block has become an anesthetic option for CAPD catheter surgery in our institution.

Incision locations may differ depending on surgeons and institutions. Preoperative confirmation of the incision site is most important for providing effective analgesia. Lateral TAP block or rectus sheath block may be selected for incision sites located on the lower abdominal wall or on more medial areas, respectively. Bilateral blocks may be required when incisions cross widely over the midline. Different blocks can also be combined to obtain wider analgesic areas [12]. In our case 4, no additional LA was required under bilateral subcostal TAP block (Table 1).

Other peripheral nerve blocks of the trunk, such as thoracic paravertebral or quadratus lumborum blocks, may provide extended analgesia as compared with TAP block, as the LA spreads more widely in the longitudinal direction and may involve LCBs [7]. However, these blocks should be more strictly limited by coagulation abnormalities than TAP block as the LA injection sites are deeper. More studies on peripheral nerve blocks of the trunk are necessary to understand their effects.

## Conclusions

MAC based on ultrasound-guided subcostal TAP block is a useful anesthetic technique for abdominal wall surgeries, including CAPD catheter surgery. It is particularly useful for patients with poor cardiopulmonary function for whom other anesthetic methods are contraindicated.

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