



# Comparison between effects of local wound infiltration, transabdominal plane block, and electrical twitch obtaining intramuscular stimulation on the postoperative pain in pylorus preserving pancreaticoduodenectomy: a double-blind randomized control trial

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## Purpose

- Background** After pylorus-preserving pancreaticoduodenectomy (PPPD), retracted abdominal muscles cause inflammatory changes which elicit postoperative pain and result in decrease in function. Various interventions have been applied to manage postoperative pain so far.
- Purpose** In order to determine which minimally invasive intervention is the most successful at controlling pain, this study compared three different types of modalities: local wound infiltration (LWI), four quadrant transversus abdominis plane (4QTAP) block, and needle electrical twitch obtaining intramuscular stimulation (NETOIMS).

## Material and Methods

### Study population

- Between January 2021 and September 2022, 72 patients who underwent PPPD
- RCT: random assignment to a LWI, 4QTAP, and NETOIMS group

### Intervention

- 1) LWI group:** On Q pump into a surgical wound, the pump was filled with 1,650 mg of ropivacaine, and was removed on POD3.
- 2) 4QTAP group:** immediately after the anesthetic induction, the patients received the TAP block in four quadrants under the ultrasound guidance with 10 mL of ropivacaine 0.375% on each site
- 3) NETOIMS group:** NETOIMS was applied in the transverse abdominis muscle under ultrasound guidance immediately after operation under general anesthesia.

### Outcome

- 1) Primary outcome: pain score (numeric rating scale, 0-100) was recorded at POD-1~3, 5~7, 14, and 28.
- 2) Secondary outcomes: the peak cough flow (PCF), and gait speed were repeatedly measured at POD-1, 2, 7, 14, and 28.

### Statistical analysis

- Intergroup differences of the demographic, preoperative, perioperative, and postoperative characteristics were analyzed using Analysis of Variance (ANOVA).
- The pain score, PCF, and gait speed were analyzed using repeated measures ANOVA.

## Results

- Clinical data of a total 68 patients were finally analyzed. Demographic, preoperative, and postoperative characteristics did not show intergroup differences, except 4QTAP group showed less elevated mean arterial pressure (MAP) 1 minute after skin incision and used less amount of remifentanyl compared to the LWI and NETOIMS group (Table 1).
- Postoperative pain score was significantly lower in 4QTAP and NETOIMS group compared to the LWI group on POD0~7. Consumption of both morphine and ibuprofen until POD3 were significantly less in 4QTAP and NETOIMS group compared to LWI group. There were no intergroup differences in prevalence of analgesic-related complication (Table 2).
- Postoperative PCF (A) and gait speed (B) compared to the preoperative values are plotted (Fig. 1). While there are no differences between the three groups, functional performance tends to be highest in the NETOIMS group through graphs.

Table 1. Baseline characteristics

Variables	LWI (N = 22)	4QTAP (N = 23)	NETOIMS (N = 23)	P
<b>I. Demographic characteristics</b>				
Sex				0.204
Male	10(46)	8(33)	14(61)	
Female	12(55)	15(65)	9(39)	
Age, yr	66(10)	66(13)	69(8)	0.469
Body mass index, kg/m <sup>2</sup>	21.4(2.1)	22.4(3.4)	21.8(2.8)	0.478
<b>II. Preoperative characteristics</b>				
Diagnosis				0.307
Pancreatic cancer	8(36)	9(39)	10(44)	
Duodenal cancer	0(0)	3(13)	0(0)	
Common bile duct cancer	8(36)	6(26)	9(39)	
Ampulla of Vater cancer	6(27)	5(22)	4(17)	
ASA physical status				0.990
I	7(32)	8(35)	7(30)	
II	12(55)	11(48)	12(52)	
III	3(14)	4(17)	4(17)	
IV	0(0)	0(0)	0(0)	
V	0(0)	0(0)	0(0)	
<b>Functional performance</b>				
Peak cough flow, L/min	362(126)	363(110)	321(125)	0.413
Gait speed, m/s	40(7)	38(8)	37(12)	0.612
<b>III. Perioperative characteristics</b>				
Operation time, min	321(56)	336(55)	346(87)	0.478
Amount of remifentanyl, µg/kg/hr	4.3(1.5)	3.1(1.0)*†	4.1(1.3)	0.006
Mean arterial pressure, mmHg				
1 min before skin incision	78(11)	79(11)	73(8)	0.140
1 min after skin incision	94(17)	81(10)*†	94(18)	0.005
Heart rate, beats/min				
1 min before skin incision	67(17)	75(14)	69(12)	0.150
1 min after skin incision	73(18)	75(31)	83(15)	0.270
<b>IV. Postoperative characteristics</b>				
Clavien-Dindo classification				0.908
None	18(82)	17(74)	17(74)	
I-II	3(14)	5(22)	4(17)	
III-IV-V	1(5)	1(4)	2(9)	
Length of hospital stay, days	12(6)	12(3)	12(3)	0.946

Values are presented as number of patients (%) or mean (standard deviation). LWI, local wound infiltration; 4QTAP, four quadrant transversus abdominis plane block; NETOIMS, needle electrical twitch obtaining intramuscular stimulation; ASA, American Society of Anesthesiologists.

\*P < 0.05, compared to LWI group. †P < 0.05, compared to group NETOIMS.

Figure 1. Postoperative peak cough flow and gait speed

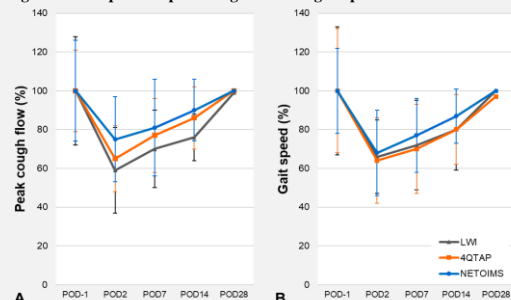


Table 2. Postoperative variables related to pain scores and use of analgesics

Variables	LWI (N = 22)	4QTAP (n = 23)	NETOIMS (n = 23)	P
<b>Pain score, NRS (0-100)</b>				
POD0	67(12)	37(18)*	38(17)*	< 0.001
POD1	52(17)	31(11)*	31(18)*	< 0.001
POD2	53(15)	31(14)*	31(12)*	< 0.001
POD3	51(16)	31(15)*	26(8)*	< 0.001
POD5	50(14)	29(12)*	28(12)*	< 0.001
POD7	43(20)	29(13)*	27(9)*	0.001
POD14	23(10)	18(8)	17(9)	0.072
POD28	1(5)	6(19)	1(4)	0.212
<b>Consumption of analgesics until POD3</b>				
Morphine milligram equivalents	382(85)	289(77)*	274(99)*	< 0.001
Ibuprofen	4000(1283)	2243(2078)*	2365(2096)*	0.004
<b>Analgesic-related complication</b>				
Nausea	6(27)	4(17)	7(30)	0.567
Vomiting	2(9)	3(13)	2(9)	0.867
Delayed gastric emptying	4(18)	4(17)	7(30)	0.444
Dizziness	1(5)	2(9)	1(4)	0.801

Values are presented as number of patients (%) or mean (standard deviation). LWI, local wound infiltration; 4QTAP, four quadrant transversus abdominis plane block; NETOIMS, needle electrical twitch obtaining intramuscular stimulation.

## Conclusion

The 4QTAP and NETOIMS is more effective in reducing the postoperative pain in acute phase compared to LWI. The 4QTAP seems effective in lowering the perioperative MAP which leads to reduce the amount of remifentanyl use. Future research is anticipated to look at the additive effect of 4QTAP and NETOIMS to more successfully reduce postoperative pain and improve functional performance.