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**Evaluation of Sensory Loss Obtained by Modified-Thoracoabdominal Nerves Block  
Through Perichondrial Approach in Patients Undergoing Gynecological Laparoscopic  
Surgery: A Prospective Observational Study**

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**Running Head:**

Evaluation of Sensory Loss of M-TAPA

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**Abbreviations**

M-TAPA: modified-thoracoabdominal nerves block through perichondrial approach

ASA: American Society of Anesthesiologists

IQR: interquartile range

LA: local anesthetic

TAP: transversus abdominis plane

TAPB: transversus abdominis plane block

## 1 INTRODUCTION

2 Recently, Tulgar et al. reported modified-thoracoabdominal nerves block through perichondrial  
3 approach (M-TAPA).<sup>1</sup> However, studies showing the area blocked by M-TAPA are lacking.

## 4 **METHODS**

5 In this prospective observational study, 30 patients undergoing gynecological laparoscopic  
6 surgery were recruited after obtaining ethical approval and written informed consent. Exclusion  
7 criteria were: ASA  $\geq 3$ , age  $< 20$  or  $> 70$  years, pregnancy, local anesthetics allergy, weight  $< 45$  kg,  
8 body mass index  $> 35$  kg/m<sup>2</sup>, history of thoracotomy or laparotomy except for lower abdominal  
9 laparoscopic surgery, communication disorders, neuropathy, or operation time of  $> 6$  hours.

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### 11 **M-TAPA technique**

12 M-TAPA was performed bilaterally by a single anesthesiologist (KA) after general anesthesia  
13 induction (see Figure 1A–D). The needle tip was repositioned if intramuscular spread was  
14 observed.

15

### 16 **Sensory level assessment**

17 An investigator (KA or YM) assessed sensory levels T4–L1 using a pinprick test 2 hours  
18 postoperatively. The anterior and lateral cutaneous branches were evaluated at a vertical line 3–5  
19 cm from the midline and midaxillary lines, respectively. A vertical force (1 newton) was  
20 visualized using a tension gauge. A 3-point numerical scale (0 = no pain, 1 = decreased pain, 2 =  
21 normal pain) was used: values of 0 or 1 were defined as effective. Normal sensation on the

22 shoulder was used for comparison.

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40 **RESULTS**

41       The median (IQR) highest sensory level was T7 (T5–8) in the anterior and T9 (T7–10) in the  
42 lateral area. Sensory loss was not observed in the lateral area in five patients. The median (IQR)  
43 number of blocked dermatomes was 5 (7–4) in the anterior and 4 (5–2) in the lateral area (Figure  
44 2).



45 **DISCUSSION**

46 This study evaluated the sensory levels of anterolateral thoracoabdominal wall after performing  
47 M-TAPA using 25 mL of 0.25% ropivacaine and demonstrated its inconsistency. Because 10<sup>th</sup>  
48 costal cartilage usually contacts the transversus abdominis muscle, the injected local anesthetic  
49 (LA) spreads along the transversus abdominis plane (TAP). However, our results indicated that  
50 the LA pathway differed between TAP block (TAPB) and M-TAPA. Borglum et al.<sup>2</sup> reported that  
51 LA injected to the TAP does not overcome the linea semilunaris. The anterior abdominal wall is  
52 innervated by the upper (T6–9) and lower TAP plexus (T10–12) divided by the linea semilunaris;  
53 therefore, the hydrodissection technique<sup>3</sup> or dual TAPB<sup>4</sup> is required to simultaneously anesthetize  
54 both areas. Considering the LA was injected outside the linea semilunaris, and most patients had  
55 some sensory loss in the lateral area, the LA might spread laterocranially, resulting in a sensory  
56 block. Zinboonyahgoon et al.<sup>5</sup> reported that a single LA injection to the endothoracic fascial plane,  
57 positioned immediately beneath the ribs, could achieve multi-level intercostal nerve block. Thus,  
58 that compartment could be the responsible pathway of M-TAPA. LA spread of fascial plane blocks  
59 is influenced by multiple factors.<sup>6</sup> Therefore, the features of the individual fascia allowing cranial  
60 and lateral spread may affect the sensory area. The lower rate of dermatomal coverage of the T12  
61 and L1 in the anterior area may be because of cranial needle direction.

62 This study has several limitations. Sensory areas were assessed postoperatively, and a previous

63 study demonstrated sensory ranges regressing over time.<sup>4</sup> Hence, our results may be less than the  
64 maximum height and range. Furthermore, we cannot deny the existence of performance bias and  
65 the potential residual effect of opioids. Because of several incisions and dressings, we could not  
66 evaluate the blocked area as a plane, but only on the representative longitudinal lines.

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81 **CONCLUSION**

82 The area blocked by M-TAPA varies and provides limited dermatomal coverage than  
83 previously reported. Anterior sensory coverage was marginally better than lateral coverage.  
84 Future studies should investigate the corresponding fascial plane, and perioperative analgesic  
85 efficiency of M-TAPA.

86 **ACKNOWLEDGEMENTS**

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106 **LEGENDS for figures**

107 **Figure 1:** M-TAPA technique

108 A: A high-frequency linear probe (6–13 MHz) is placed in the sagittal direction at the 10<sup>th</sup> costal  
109 margin, and transversus abdominis, internal oblique, and external oblique muscles are identified.

110 B: An 8-cm 18G Tuohy needle is inserted in the cranial direction using an in-plane technique. C:

111 The needle tip is moved to the posterior aspect of the 10<sup>th</sup> costal cartilage, following 1 mL of

112 saline injection to confirm the correct spread. D: Subsequently, 25 mL of 0.25% ropivacaine is

113 administered along with an intermittent aspiration test. It should be noted that the needle tip never

114 proceeded over the cranial edge of the 10<sup>th</sup> costal cartilage.

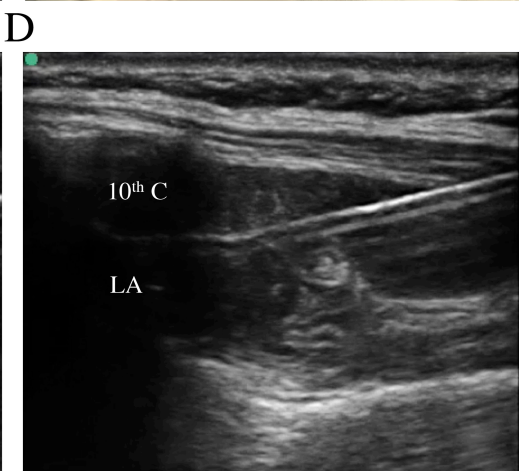
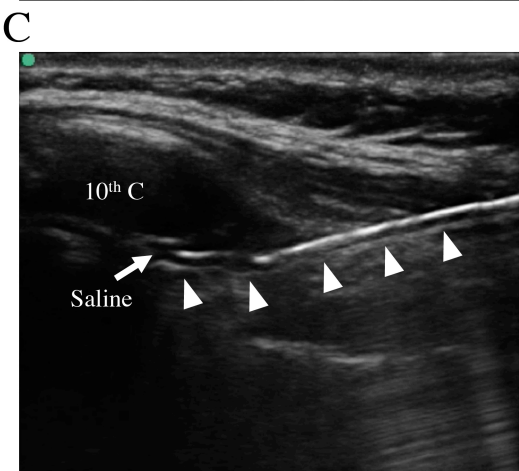
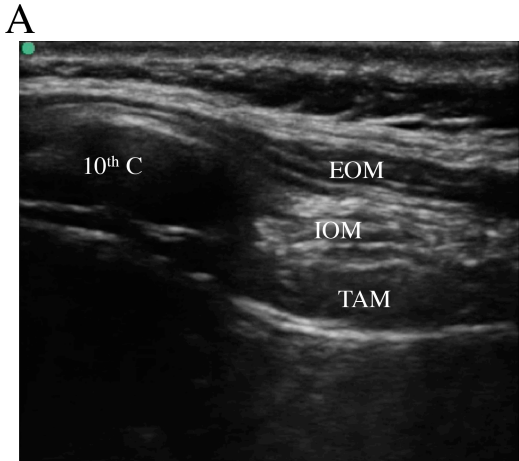
115 Abbreviations: C, costal cartilage. EOM, external oblique muscle. IOM, internal oblique muscle.

116 TAM, transversus abdominis muscle. LA: local anesthetics.

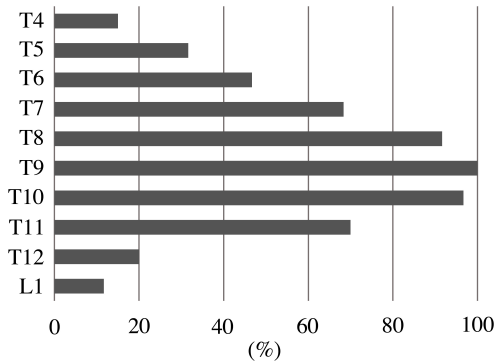
117 The white triangle symbolizes the 18G Touhy needle.

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119 **Figure 2:** Percentages of successful blocks in each dermatome.



Anterior Area



Lateral Area

