Effect of Mesoappendix Volume on Preoperative Pain of Acute Appendicitis

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ABSTRACT

Objective: To investigate the relationship between preoperative pain scores and the mesoappendix volume and the presence of complications in patients with acute appendicitis.

Study Design: Cross-sectional observational study.

Place and Duration of the Study: Department of General Surgery at Kutahya Health Sciences University, Kutahya, Turkey, from January to December 2021.

Methodology: Pain degrees in patients with acute appendicitis were measured by Numerical Rating Scale (NRS) and Wong–Baker Scale (WBS). Mesoappendix volume was calculated using the formula: mesoappendix length x width x height. Appendicitis type (as complicated or uncomplicated) was grouped.

Results: There was a positive and statistically significant correlation (17%) between the NRS and mesoappendix volume (p=0.065). In addition, there was a positive and statistically significant correlation (17%) between the WBS and mesoappendix volume (p=0.057). Additionally, there was a statistically significant relationship between the NRS, WBS, and complicated appendicitis (p=0.022, p=0.022, respectively).

Conclusion: The mesoappendix volume might contribute to preoperative pain process in acute appendicitis patients. Specifically, there is a statistically significant correlation between complicated appendicitis and preoperative pain scores.

Key Words: *Appendicitis, Pain, Mesentery, Complicated appendicitis.*

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INTRODUCTION

Acute appendicitis accounts for 7-10% of all emergency department consultations related to lower abdominal pain. It is also the most common aetiology requiring hospitalisation for acute abdomen diagnoses. Acute appendicitis has remarkable morbidity and mortality rates, especially in the case of complicated appendicitis. Thus, a prompt diagnosis is important for early intervention. Surgery remains the main treatment strategy.[1,2]

The diagnosis of acute appendicitis is challenging as it requires a combination of clinical, laboratory, and radiological findings. A migratory pain pattern is typical in patients with acute appendicitis, and thus it is an important symptom in clinical decision making. Accordingly, several clinical scoring systems are based on the level of pain related to the disease.[3]

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Pain scores have been used in surgical diseases perioperatively to predict postoperative outcomes and pain.[4,5] The numerical rating scale (NRS) and Wong–Baker faces pain rating scale (WBS) are commonly used to assess acute pain.[6] Although the pain of acute appendicitis is a cardinal symptom, the causes of preoperative pain are not well-understood.

Recently, the mesoappendix has been designated as a distinct abdominal organ, which plays embryological and immunological roles by coordinating with intra-abdominal organs.[7] The mesoappendix is a part of the mesentery, consisting of vascular and lymphatic tissues of the appendix.[8] Accordingly, the mesoappendix may be involved in pain processes.

In this study, the primary aim was to investigate the relationship between preoperative pain scores and intraoperative mesoappendix volume in appendicitis patients. The secondary aim was to analyse the relationship between these pain scores and appendicitis type (complicated or uncomplicated).

METHODOLOGY

Data of the acute appendicitis patients who underwent appendectomy between January 2021 and December 2021 at the general surgery clinic at Kutahya Health Sciences University, Kutahya, Turkey were prospectively analysed.

The power analysis was calculated by considering the primary aim of the study, which was to evaluate the relationship between mesoappendiceal volume and NRS and WBS pain scale scores. Using the statistical correlation test between the mesoappendix volume and the NRS and WBS pain scale points, a sample size of 121 was taken to reveal that the correlation value of 0.17 units which is different from the correlation value of 0, with a significance level of 0.10 (90% confidence level) and a power of 72%. The procedures were carried out through the GPower 3.1 programme.

Informed consent was obtained from the participants prior to the study. Patients who underwent open or laparoscopic appendectomy and whose entire mesoappendix was resected during the appendectomy were included in the study. Patients with any chronic gastrointestinal disease, who had gastrointestinal pain related to another pathology or who had appendectomy due to another surgical pathology as well as acute appendicitis patients whose mesoappendix was not resected and assessed during surgery were excluded from the study.

Patients' age and gender were noted prospectively. The preoperative pain levels of the patients were assessed by two pain scales, the NRS and WBS (Figure 1), just prior to the appendectomy during hospitalisation.

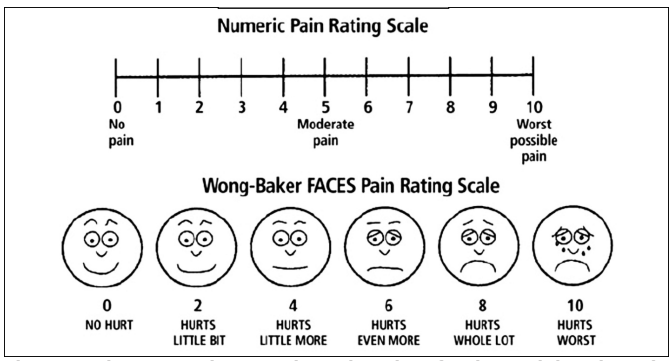

Figure 1: The NRS and WBS pain scale points for determining the pain degree of the patients.

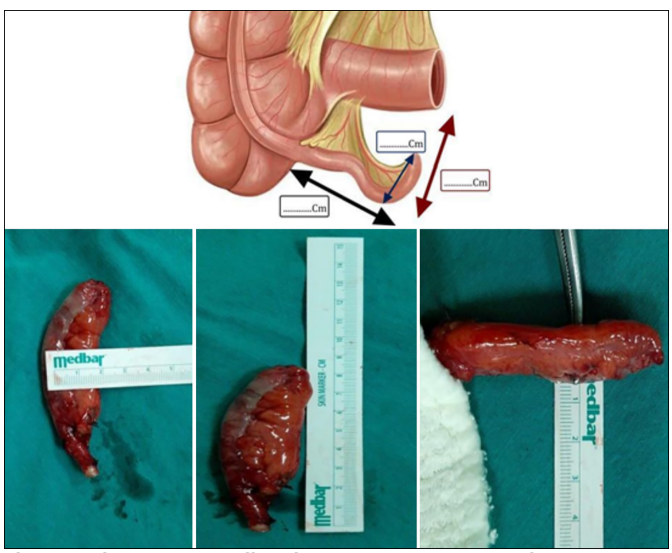

Figure 2: The mesoappendix volume measurement sample.

The NRS categorised pain numerically from 0 to 10. Scores of 0–3 indicated mild pain, scores of 4-6 indicated moderate pain and scores of 7-10 indicated intense pain.[9]

This WBS consisted of a series of illustrated faces which categorised pain from 0 ("happy face") to 10 ("a crying face"). The patient chose the face and the description that described the patient's level of pain.[10]

The intraoperative evaluation of the surgeon was used to classify appendicitis status as complicated or uncomplicated appendicitis. Additionally, mesoappendix volume was calculated (cm^3) using the formula for prism volume (mesoappendix length x mesoappendix width x mesoappendix height) (Figure 2).

The Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp., Armonk, NY) programme was used for statistical analysis. Descriptive statistics (mean, standard deviation, media, and quartiles) were given for quantitative variables, and frequency tables (n, %) were given for qualitative variables. Spearman's rho correlation coefficient was used to show the correlation between two quantitative variables. To examine the relative statuses of two qualitative variables, cross-tabs and tests were used, and Cramer's V coefficient was interpreted. To determine the differences between the groups, the normal distribution fit test was performed with the Kolmogorov–Smirnov and Shapiro–Wilk tests. The Mann–Whitney U test was used when there were two groups, and the Kruskal–Wallis test was used when there were more than two groups. Mean plot, scatter, and bar charts were also used. For statistical significance, margins of error of 0.05, 0.01, and 0.001, were indicated for statistical significance.

RESULTS

A total of 121 patients were included in the study. Of these, 76 were males (62.81%) and 45 were females (37.19%). The mean age of the patients was 35.9 (19-90) years. The mean mesoappendix volume was 22.5 (2–200) cm^3. The mean preoperative NRS and WBS scores are shown in Table I.

Table I: Preoperative NRS and WBS pain scale points of the acute appendicitis' patients.

		Frequency (n)	Percentage (%)
NRS pain scale points	2	3	2.50
	3	2	1.70
	4	17	14.00
	5	20	16.50
	6	42	34.70
	7	10	8.30
	8	24	19.80
	9	2	1.70
	10	1	0.80
	Total	121	100.00
WBS pain scale points	2	5	4.10
	4	9	7.40
	6	67	55.40
	8	36	29.80
	10	4	3.30
	Total	121	100.00

Table II: Statistical correlation between the mesoappendix volume and NRS and WBS pain scale points.

Correlations			Volume of the mesoappendix (cm^3)
Spearman's rho	NRS pain score	Correlation coefficient	0.17
		Sig. (2-tailed)	0.065
		n	121
Spearman's rho	WBS pain score	Correlation coefficient	0.17
		Sig. (2-tailed)	0.057
		n	121

Table III (a): The relationship between the NRS pain scale points and appendicitis type.

Appendicitis type and NRS pain scale	NRS pain scale points									Total
	2	3	4	5	6	7	8	9	10	
Appendicitis type										
Complicated	0	0	2	2	9	5	12	1	0	31
	0.0%	0.0%	6.5%	6.5%	29.0%	16.1%	38.7%	3.2%	0.0%	100.0%
Uncomplicated	3	2	15	18	33	5	12	1	1	90
	3.3%	2.2%	16.7%	20.0%	36.7%	5.6%	13.3%	1.1%	1.1%	100.0%
Total	3	2	17	20	42	10	24	2	1	121
	2.5%	1.7%	14.0%	16.5%	34.7%	8.3%	19.8%	1.7%	0.8%	100.0%

Chi-square: 17.956; Cramer's V:0.385; p-value: 0.022.

Table III (b): The relationship between the WBS pain scale points and appendicitis type.

Appendicitis type and WBS pain scale	WBS pain scale points					Total
	2	4	6	8	10	
Appendicitis type						
Complicated	0	1	11	16	3	31
	0.0%	3.2%	35.5%	51.6%	9.7%	100.0%
Uncomplicated	5	8	56	20	1	90
	5.6%	8.9%	62.2%	22.2%	1.1%	100.0%
Total	5	9	67	36	4	121
	4.1%	7.4%	55.4%	29.8%	3.3%	100.0%

Chi-Square: 17.506; Cramer's V: 0.380; p-value:0.002.

Table II shows the correlations between the mesoappendix volume and WBS and NRS scores. Based on the analysis, there was a positive correlation (17%) between the NRS and the mesoappendix volume. This relationship was statistically significant (margin of error = 0.10, p = 0.065). There was a positive correlation (17%) between the WBS and the mesoappendix volume. This relationship was statistically significant with a margin of error of 0.10 (p = 0.057).

Table III (a and b) shows the relationship between the NRS and WBS and appendicitis type. The correlation between appendicitis type and NRS score was approximately 39%, and this relationship was statistically significant (p=0.022). Patients with an NRS score of 8 were significantly more likely to have complicated appendicitis, while those with an NRS score of 6 were significantly more likely to have uncomplicated appendicitis.

There was a correlation of approximately 38% between appendicitis type and WBS score, and this relationship was statistically significant (p=0.022). Patients with a WBS score of 8 were significantly more likely to have complicated appendicitis, while those with a WBS score of 6 were significantly more likely to have uncomplicated appendicitis.

DISCUSSION

This prospective study analysed the mesoappendix volume affecting appendicitis patients' preoperative pain scores. Specifically, the mesoappendix volume was measured and analysed to determine its relationship with preoperatively assessed NRS and WBS scores. Furthermore, the correlation between these pain scores and appendicitis type was evaluated.

Accordingly, the correlation between the mesoappendix volume and preoperative pain scores was statistically significant to a low positive degree. This result might be interpreted to indicate that the pain pathogenesis of patients with acute appendicitis is complex and has additional aetiological factors that have not yet been revealed. One of the potential factors affecting the visceral pain of patients with acute appendicitis was related to gut microbiota. Animal models had demonstrated that alterations of the microbiota led to changes in local immunity, resulting in the disturbance of central pain signalling and causing visceral hypersensitivity.[11] Hence, probiotics and antibiotic treatments might lead to dyshomeostasis of gut microbiota and thereby, play a key role in visceral hypersensitivity.[12] In this study, patients were not asked about preoperative antibiotic or routine probiotic use.

Di Sebastiano *et al*. found that abnormal neuropeptide, substance P, and vasoactive intestinal peptide contents in the mucosal layer of acute appendicitis patients could contribute to the pain pathogenesis.[13] Neuroimmune appendicitis is associated with increased expression of neuroimmune modulators, such as S-100 protein, synaptophysin, enolase, and PGE2 in different appendiceal layers. These molecules are also associated with pain in non-inflamed appendix tissue.[14] The mesoappendix consists of fibrofatty tissue, which is highly variable in size and contains vascular, lymphatic vessels, nerves, and lymph nodes.[15] Thus, it is predictable that a high mesoappendix volume might lead to a strong immunologic response and higher pain scores in patients with acute appendicitis. Studies with higher patients' volume may better reveal the role of the mesoappendix regarding pain pattern and degree of the pain in acute appendicitis patients.

Another potentially confounding factor to consider is the subjective characteristic of the pain. It can be influenced by physiologic, sensory, affective, cognitive, socio-cultural, and behavioural factors.[16] To reduce potential false evaluations of preoperative pain, we used two different pain scales were used, both of which showed similar statistical relationship with the mesoappendix volume. Additionally, the two different pain score assessments of the patients were internally consistent.

One of the prominent findings of the study was that there was a statistically significant correlation between complicated appendicitis and NRS and WBS scores. Complicated appendicitis had significantly higher morbidity than uncomplicated appendicitis, and it was associated with a greater pain duration.[17] Preoperative pain was more likely in complicated appendicitis related to peritonitis caused by perforation.

Preoperative pain scores are subjective and based on patient's self-assessment. The mesoappendix volume was measured using a classic geometric volume measurement in cm^3, so the actual volume of the mesoappendix may be somewhat different from the measured volume. The study sample at the minimum required to demonstrate the relevance of actual statistical results.

CONCLUSION

The results of this study revealed that the mesoappendix volume was positively correlated with preoperative pain scores in acute appendicitis patients. Complicated appendicitis was statistically significantly correlated with the preoperative pain scores. These results highlighted the importance of the mesoappendix in pain processes as a premise.

DISCLOSURE:
This study was presented as oral presentation in "II. International colorectal surgery congress, XIX. National colon and rectal surgery congress and XII. National, I. International colorectal surgery nursing congress" on May 16-20, 2023 at Antalya,Turkey.

ETHICAL APPROVAL:
This study was approved by Kutahya Health Sciences University's Ethical Committee (2020/18-08). This study complied with the Declaration of Helsinki.

PATIENTS' CONSENT:
Informed consent was obtained from the participants prior to the study.

COMPETING INTEREST:
The authors declared no competing interest.

AUTHORS' CONTRIBUTION:
ACY, HEA, MFE: Data acquisition.
ACY, SZ, OA: Drafting of manuscript.
MCA: Critical revision of manuscript.
The manuscript has been read and approved by all the authors, the requirements for authorship as stated earlier in this document have been met, and each author believes that the manuscript represents honest work.

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