Original Article / Özgün Makale

MEDICINE PALLIATIVE CARE

DOI: 10.47582/jompac.1070406

J Med Palliat Care 2022; 3(1): 44-49

Pain score and other factors affecting the postoperative discharge time of patients who underwent lung resection: a retrospective study

Akciğer rezeksiyonu yapılan hastaların postoperatif taburculuk süresini etkileyen ağrı skoru ve diğer faktörler: retrospektif çalışma

Gülay Ülger[1], Musa Zengin[1], Funda İncekara[2], Ramazan Baldemir[1], Hilal Sazak[1], Ali Alagöz[1]

[1]Ankara Atatürk Chest Diseases and Thoracic Surgery Training and Research Hospital, University of Health Sciences, Anesthesiology and Reanimation Clinic, Ankara, Turkey

[2]Ankara Atatürk Chest Diseases and Thoracic Surgery Training and Research Hospital, University of Health Sciences, Thoracic Surgery Clinic, Ankara,Turkey

Cite this article as/Bu makaleye atıf için: Ülger G, Zengin M, İncekara F, Baldemir R, Sazak H, Alagöz A. Pain score and other factors affecting the postoperative discharge time of patients who underwent lung resection: a retrospective study. J Med Palliat Care 2022; 3(1): 44-49.

ABSTRACT

Aim: Many factors affect the hospitalization period of patients after surgery. One of the most important of them is postoperative pain. Our study aims to investigate the relationship between the postoperative discharge time and the postoperative 24-hour visual analog scale (VAS) pain scores of patients who underwent thoracotomy and lung resection. Additionally, we also want to identify the parameters that affect the day of discharge, VAS scores, and chest tube removal time of these patients.

Material and Method: Data of patients who underwent elective thoracic surgery between February 2021 and August 2021 in a tertiary chest disease and thoracic surgery center were analyzed patients aged between 18 and 75 years, in the ASA I-II-III risk group, with a body mass index (BMI) in the range of 18.5-35 kg/m², who underwent thoracotomy and resection due to lung malignancy. Following data were extracted co-morbidities, diagnoses, performed surgery, type of surgery, duration of surgery, intraoperative complications, intraoperative blood product transfusion history, postoperative advanced complications, postoperative 24-hour VAS, length of stay, and length of chest tube stay.

Results: A total of 104 patients who underwent elective thoracotomy and lung resection under general anesthesia between February 2021 and August 2021 were included in the study. There was a positive and highly statistically significant correlation between discharge time and chest tube removal time ($p < 0.001$). There was no statistically significant correlation between discharge times and VAS scores ($p=0.553$). Additionally, there was no statistically significant correlation between VAS scores and chest tube removal time. Discharge time had a low positive and statistically significant correlation with age ($p=0.027$), and with the duration of the operation ($p < 0.001$). There was a low degree of negative statistically significant correlation between discharge day and BMI ($p=0.017$).

Conclusion: While the prolonged chest tube withdrawal time was directly related to the longer discharge time, the VAS scores have no significant correlation with the discharge time and the chest tube removal time. Additionally, age and operation time were also found to be associated with prolonged discharge time. Prospective comprehensive studies on this subject will be useful in clarifying the factors affecting the discharge time after thoracic surgery.

Keywords: lung resection, pain, postoperative discharge time, thoracotomy, visual analog scale

ÖZ

Amaç: Birçok faktör hastaların cerrahi sonrası hastane yatış sürelerini etkilemekle birlikte bunlardan en önemlisi postoperatif ağrıdır. Bu çalışmamızdaki birincil amacımız torakotomi ile akciğer rezeksiyonu yapılan hastaların postoperatif taburculuk süresi ile postoperatif ilk 24 saatlik vizuel analog skala (VAS) ağrı skorları arasındaki ilişkiyi araştırmaktır. İkincil olarak bu hastalarda taburculuk gününü, VAS skorları ve göğüs tüpü çekilme zamanını etkileyen parametreleri tespit etmektir.

Gereç ve Yöntem: Çalışmamız, üçüncü basamak göğüs hastalıkları ve göğüs cerrahisi merkezi olan hastanemizde Şubat 2021 ve Ağustos 2021 tarihleri arasında elektif olarak göğüs cerrahisi ameliyatı olan hastalar postoperatif olarak incelenmiştir. 18-75 yaş arası, ASA I-II-III risk grubunda olan, vücut kitle indeksi (VKİ) 18,5-35 kg/m² aralığında olan, torakotomi ile akciğer malignitesi sebebiyle rezeksiyon uygulanmış hastalar çalışmamıza dâhil edilmiştir. Hastaların anestezi kayıtlarından ve dosyalarından yandaş hastalıklar, tanılar, yapılan ameliyat, ameliyat tipi, ameliyat süresi, intraoperatif komplikasyonlar, intraoperatif kan ürünü transfüzyonu öyküsü, postoperatif gelişmiş komplikasyonlar, postoperatif 24 saatlik VAS skorları, yatış süreleri, ve göğüs tüpü kalış süreleri gibi veriler kaydedilmiştir.

Bulgular: Şubat 2021-Ağustos 2021 tarihleri arasında genel anestezi altında elektif torakotomi ve akciğer rezeksiyonu yapılan toplam 104 hasta çalışmaya dahil edildi. Taburcu olma süresi ile göğüs tüpü çekilme süresi arasında pozitif ve istatistiksel olarak anlamlı bir ilişki bulundu ($p < 0,001$). Taburculuk süreleri ile VAS skorları arasında istatistiksel olarak anlamlı bir ilişki bulunamadı ($p=0,553$). VAS skorları ile göğüs tüpü çekilme zamanı arasında istatistiksel olarak anlamlı bir ilişki de bulunamadı. Taburculuk günü ile yaş ($p=0,027$) ve taburculuk günü ile operasyon süresi ($p < 0,001$) arasında düşük derecede pozitif yönlü istatistiksel olarak anlamlı korelasyon bulundu. Taburculuk günü ile VKİ arasında düşük derecede negatif yönlü istatistiksel olarak anlamlı bir korelasyon bulundu ($p=0,017$).

Sonuç: Göğüs tüpü çekilme zamanının uzaması taburculuk süresinin uzaması ile doğrudan ilişkili iken, VAS skorları ile taburculuk süresi ve göğüs tüpü çekilme zamanı arasında anlamlı bir korelasyon gözlenmemiştir. Ayrıca, yaş ve operasyon süresi de taburculuk süresinin uzaması ile ilişkili bulunmuştur. Bu konuda yapılacak prospektif kapsamlı çalışmalar göğüs cerrahisi sonrası taburculuk süresini etkileyen faktörlerin açığa kavuşturulmasında faydalı olacaktır.

Anahtar kelimeler: Akciğer rezeksiyonu, ağrı, postoperatif taburculuk süresi, torakotomi, vizuel analog skala

Corresponding Author/Sorumlu Yazar: Gülay Ülger, Health Sciences University Ankara Atatürk Chest Diseases and Thoracic Surgery Training and Research Hospital, Anesthesiology and Reanimation Clinic, Ankara, Turkey
E-mail/E-posta: gulayulger@gmail.com
Received/Geliş: 09.02.2022 **Accepted/Kabul:** 25.02.2022

INTRODUCTION

Many factors affect the hospitalization period of patients after surgery. One of the most important of them is postoperative pain (1). Thoracic surgery, particularly thoracotomy, is one of the most painful surgical procedures known (2). Thoracic epidural analgesia (TEA) is a gold standard in pain management after thoracic surgery. However, side effects, such as sympathetic blockade, respiratory depression, urinary retention, and serious conditions such as epidural hematoma and abscess may also be encountered (3).

Thoracic paravertebral block (TPVB) offers similar analgesia to TEA but causes fewer postoperative complications (4). Therefore, the usage of TPVB and other regional nerve block applications after thoracic surgery has increased in recent years (3,5-7). In addition to regional block applications; intravenous analgesia treatments, such as opioids, paracetamol, non-steroidal anti-inflammatory drugs, are also applied as a component of multimodal analgesia (8,9).

With the development of the thoracoscopy technique, the smaller incisions in video-assisted thoracic surgery (VATS) help to reduce the postoperative pain, however, acute severe pain that develops after thoracotomy is still a difficult situation to control (3). After these types of surgery, the most common source of the pain can be listed as surgical incision, rib injury, and chest tubes (2). Additionally, postoperative pulmonary complications, such as pain-related atelectasis and pneumonia, may develop and pain may result in longer hospital stays (2, 3). It is also known that acute pain increases postoperative morbidity and prolongs hospital stay (10, 11). Due to poor postoperative pain control, prolonged hospitalization, decreased patient satisfaction, and prolonged immobilization have been reported in studies (12, 13).

Many factors affect postoperative pain, such as obesity, young age, preoperative preparation of the patient, postoperative analgesia methods, type of the surgery, duration of the operation, perioperative complications, number of chest tubes, and length of stay (14). Although all these parameters are associated with pain, they also affect the postoperative discharge times of the patients.

Our study aims to investigate the relationship between the postoperative discharge time and the postoperative 24-hour visual analog scale (VAS) pain scores of patients who underwent thoracotomy and lung resection. Additionally, we also want to identify the parameters that affect the discharge time, VAS scores, and chest tube removal time of these patients.

MATERIAL AND METHOD

The study was initiated with the approval of the Ankara Training and Research Hospital Ethics Committee (Date: 11.01.2022, Decision No: 2012-KEAK-15/2448), data of patients who underwent elective thoracic surgery between February 2021 and August 2021 in a tertiary chest disease and thoracic surgery center were analyzed. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Following patients were included in the study: Patients aged between 18 and 75 years, in the American Society of Anesthesiologists (ASA) I-II-III risk group, with a body mass index (BMI) in the range of 18.5-35 kg/m², who underwent thoracotomy and resection due to lung malignancy. Following patients were excluded from the study: Patients under the age of 18 and over the age of 75, BMI below 18.5 kg/m² and above 35 kg/m², with advanced co-morbidity, with ASA score greater than III, operated under emergency conditions, and did not undergo thoracotomy. Additionally, patients with previous lung surgery, previous COVID-19 pneumonia, and diagnosis of pleural effusion and hemoptysis were not included in the study.

The medical records of patients were analyzed and the following data were extracted: age, height, body weight, BMI, gender, ASA score, co-morbidities, diagnoses, performed surgery, type of surgery, duration of surgery, intraoperative complications, intraoperative blood product transfusion history, postoperative advanced complications, postoperative 24-hour VAS, length of stay, and length of chest tube stay. Pulmonary infection, atelectasis, cardiopulmonary edema, pleural effusion, pneumothorax, pulmonary embolism, empyema, and hemoptysis were recorded as postoperative pulmonary complications during the patients' hospitalization period. Additionally, complications such as other cardiac, neurological and nephrological were recorded as extrapulmonary complications.

Analgesia Protocol

Before the end of the surgical procedure, TPVB was performed, the insertion site was identified at 2.5 cm lateral of the spinous process at the level of T5-T6. After the transverse process was felt with the needle, the needle was pulled back and directed 1 cm toward the upper side of the transverse process. Then, 20 mL of 0.5% bupivacaine was injected through the needle. 10 mg IV metoclopramide was administered to prevent nausea and vomiting and 100 mg IV tramadol with 50 mg IV dexketoprofen was administered for analgesia at the end of the surgery. Intravenous morphine was administered via patient-controlled analgesia (PCA) pump for 24 hours in the postoperative surgical intensive care unit. The PCA pump's dose delivery was limited to administering a bolus dose of 1 mg morphine and delivering a maximum dose

of 12 mg morphine in total within four hours with lockout intervals of 15 minutes. Paracetamol 1 g every 8 hours and dexketoprofen 50 mg twice daily were administered intravenously for multimodal analgesia. As a rescue analgesic agent, 0.5 mg/kg tramadol was given to patients intravenously when a score of VAS at rest is greater or equal to 4. The side effects such as allergic reactions, hypotension, nausea-vomiting, and itching were recorded.

Statistical Analyses

Data analyses were performed by using SPSS for Windows, version 22.0 (SPSS Inc., Chicago, IL, United States). Whether the distribution of continuous variables was normal or not was determined by the Kolmogorov Smirnov test. Levene's test was used for the evaluation of homogeneity of variances. Unless specified otherwise, continuous data were described as mean±standard deviation for normal distributions, and median (interquartile range) for skewed distributions. Categorical data were described as the number of cases (%). Statistical analysis differences between two independent groups, not normally distributed variables, were compared by the Mann-Whitney U test. Categorical variables were compared using Pearson's Chi-Square test or Fisher's exact test. Univariate and multivariate linear regression analyses were performed to find risk factors and assess the association between discharge times, VAS scores, and chest tube removal times. The degrees of the relationship between variables were evaluated with Spearman correlation analysis. p-value < 0.05 was accepted as statistically significant on all analyses.

RESULTS

A total of 104 patients who underwent elective thoracotomy and lung resection under general anesthesia between February 2021 and August 2021 were included in the study (**Figure 1**). Demographic data and surgical characteristics of the patients are given (**Table 1**).

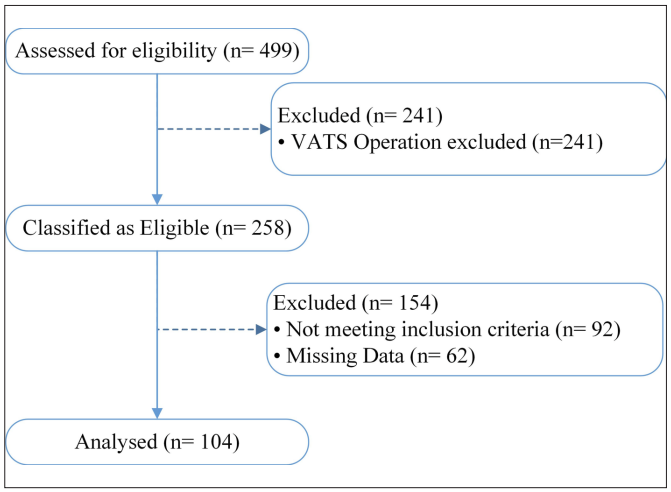

Figure 1. Flow chart of the patients

Table 1. Demographic characteristics of patients, operational characteristics, discharge Day, VAS scores and time of chest tube removal

	Patients (n:104)
Gender	
Women	30 (28.8%)
Men	74 (71.2%)
Age (year)	60.00 (3.0)
BMI kg/m²	27.72 (7.09)
Co-morbidity	
Hypertension	36 (40%)
Diabetes Mellitus	21 (23.3%)
Coronary Artery Disease	12 (13.3%)
Chronic Obstructive Lung Disease –Asthma	9 (10%)
Extra Pulmonary Malignancy	3 (3.3%)
Goiter	5 (5.5%)
Other	4 (4.4%)
ASA	
ASA II	34 (32.7%)
ASA III	70 (67.3%)
Operation Side	
Left	50(48.1%)
Right	54(51.9%)
Operation Duration (minute)	240.73±83.30
Additional Analgesic	7(6.7%)
PPCs	30(28.8%)
Extra Pulmonary Complications	3(2.9%)
Discharge Time (Day)	7.00 (3.00)
VAS Score (average of 24 hours postoperatively)	3.20 (1.60)
Chest tube removal time (Day)	5.00 (3.00)

Continuous variables are expressed as either mean±standard deviation (SD) or median (interquartile range). Categorical variables are expressed as either frequency or percentage. ASA: American Society of Anesthesiologists; BMI: Body Mass Index; PPCs: Postoperative Pulmonary Complication; VAS: Visual Analog Scale

The correlation analysis between discharge time, VAS scores, and chest tube removal time was analyzed. There was a positive and highly statistically significant correlation between discharge time and chest tube removal time (p < 0.001). There was no statistically significant correlation between discharge times and VAS scores (p=0.553). Additionally, there was no statistically significant correlation between VAS scores and chest tube removal time (p=0.690) (**Table 2**).

Table 2. The correlation between patients' discharge time, visual analogue scale (VAS) pain score, and chest tube removal time

		Discharge time (day)	VAS score	Chest tube removal time (day)
Discharge time (day)	r	1.000		
	p	.		
VAS score (average of the first 24 hours)	r	-0.059	1.000	
	p	0.553	.	
Chest tube removal time (day)	r	0.736	0.040	1.000
	p	<0.001	0.690	.

r: correlation coefficient, Spearman Correlation, VAS: Visual Analog Scale

The correlation analysis between discharge time, VAS scores, chest tube removal time and age, BMI, and operation time of the patients were performed. Discharge time had a low positive and statistically significant correlation with age (p=0.027), and with the duration of the operation (p < 0.001). There was a low degree of negative statistically significant correlation between discharge day and BMI (p=0.017). The VAS score had a low degree of positive statistically significant correlation with BMI (p=0.018) and operation time (p=0.001). The time of chest tube removal also had a low degree of positive statistically significant correlation with age (p=0.017) and with operation time (p < 0.001) (**Table 3**).

Table 3. The correlation between patients' discharge time, visual analogue scale (VAS) pain score, chest tube removal time, age, body mass index, and operation duration

		Discharge time (day)	VAS score	Chest tube removal time (Day)
Age (year)	r	0.217	-0.148	0.235
	p	0.027	0.133	0.017
BMI (kg/m²)	r	-0.234	0.231	-0.182
	p	0.017	0.018	0.067
Operation Duration (minute)	r	0.356	0.332	0.376
	p	<0.001	0.001	<0.001

r: correlation coefficient, Spearman Correlation, BMI: Body Mass Index

Discharge time and chest tube removal time in patients with PPC were statistically significantly higher than in patients without PPC (p < 0.05). The presence of extrapulmonary complications had no statistically significant relationship with discharge time, chest tube removal time, and VAS score (p > 0.05) (**Table 4**).

Table 4. The relationship between discharge day, VAS scores and chest tube removal time in patients with postoperative pulmonary complications and extra pulmonary complications

		Discharge time (day) med (IQR)	VAS score med (IQR)	Chest tube removal time (day) Med (IQR)
PPCs	Yes	6 (3)	3.1 (1.6)	5 (3)
	No	9 (7)	3.4 (1.5)	8 (7)
	p	<0.001	0.722	<0.001
Extra Pulmonary Complications	Yes	7 (3)	3.3 (1.6)	5 (3)
	No	4 (12)	1.5 (2.9)	4 (12)
	p	0.592	0.055	0.970

Med: Median, IQR: Interquartile range, VAS: Visual Analog Scale, PPCs: postoperative pulmonary complications

Univariate and multivariate linear regression analyses were applied to determine the factors affecting the discharge time of the patients. The results revealed that PPCs formation and prolongation of chest tube withdrawal were associated with prolonged discharge time (**Table 5**).

Univariate and multivariate linear regression analyses were used to determine the factors affecting the VAS scores of the patients. According to the results of the multivariate linear regression analysis, the increase in the operation time and the occurrence of extrapulmonary complications were the factors that increase the VAS score (p < 0.05).

Univariate and multivariate linear regression analyses were performed to determine the factors affecting the chest tube removal time of the patients. According to the results, the prolonged operation time and the formation of PPCs are the factors that increase the time of chest tube withdrawal (p<0.05).

DISCUSSION

In our study, the factors affecting the discharge time of patients who underwent thoracotomy and lung resection were evaluated. The postoperative 24-hour VAS scores had no significant correlation with the discharge time and with chest tube withdrawal time. Chest tube withdrawal time, age, and operation time were associated with prolonged discharge time.

Outpatient surgery and methods that decrease the discharge time have become one of the main topics in all surgical branches. Enhanced recovery after surgery (ERAS) is an increasingly accepted practice and has gained popularity in thoracic surgery as well. ERAS protocols aim to ensure rapid discharge. For this, ERAS protocols try to reduce the complications that may develop in patients by applying less invasive surgical techniques and by providing effective analgesia (15-17). Similarly, chest tube management following thoracic surgery procedures has an important role in rapid discharge (18).

Table 5. The results of univariate and multivariate linear regression analysis applied to determine the factors affecting the discharge days of the patients

Dependent variable : discharge time (day)	Univariate linear regression analyze					Multivariate linear regression analyze				
	Beta	t	p	95,0% CI for B		Beta	t	p	95,0% CI for B	
				Lower	Upper				Lower	Upper
Age (year)	0.219	2.267	0.026	0.010	0.147	0.001	-0.009	0.993	-0.036	0.035
Gender (reference : Woen)	0.250	2.603	0.011	0.535	3.961	0.085	1.739	0.085	-0.105	1.579
BMI kg/m²	-0.165	-1.688	0.095	-0.294	0.024					
Operation Side	-0.172	-1.758	0.082	-2.981	0.179					
Operation Duration (minute)	0.303	3.212	0.002	0.006	0.024	0.058	1.218	0.226	-0.002	0.007
PPCs	0.603	7.643	<0.001	4.025	6.846	0.137	2.498	0.014	0.249	2.181
Extra Pulmonary Complications	0.024	0.242	0.809	-4.202	5.371					
VAS	-0.112	-1.141	0.257	-0.926	0.250					
Chest Tube Removal Time (Day)	0.884	18.946	<0.001	0.748	0.923	0.764	13.566	<0.001	0.617	0.828

β; Standardized Coefficients, R2:0,811, Anova p<0,001, BMI: Body Mass Index, PPCs: Postoperative Pulmonary Complications, VAS: Visual Analog Scale

In the literature, many studies focus on different aspects of postoperative chest tube management in thoracic surgery (18, 19). According to these studies, prolonged chest tube application can prolong the hospital stay and can increase complications. Furthermore, the optimal timing of chest tube withdrawal has been debated for a long time, and many medical centers rely on the volume output threshold to decide the appropriate time for chest tube removal (19). The appropriate thresholds for output volumes have also been analyzed. Some surgeons argue that higher daily volume outputs (450-500 cc) should be used as acceptable thresholds for chest tube removal (20).

After surgery, many patients can be discharged the same day after chest tube withdrawal, however, others may require a longer stay. Furthermore, some factors such as chronic comorbidities, obesity, and smoking history are also important in prolonging the duration of the chest tube. For shortening the chest tube withdrawal time, indirectly the discharge time; a center-based algorithm can be an appropriate approach (18). In this study; the prolonged operation time and the development of PPCs were evaluated as effective factors in the prolonged chest tube withdrawal time, and this was also evaluated as a factor affecting the discharge time.

Effective perioperative analgesia is one of the most important components of ERAS. This situation can be achieved with a comprehensive multimodal perioperative analgesia management in which regional techniques are also applied (14, 15, 17). In our study, there was no correlation between VAS scores and discharge times. Low VAS scores observed in patients in the postoperative period indicate that effective analgesia is achieved for these patients. Since effective analgesia was provided in almost all of the patients, complications that may occur due to pain were not observed. We think that this is the reason why there was no relationship between VAS scores and discharge times in our study.

The duration of the operation, age, and BMI are among the factors that affect the discharge time (18). Studies have shown that the longer the BMI, the longer the discharge time. This can be explained by the increase in PPCs in obese patients. Unlike these results, in our study, no relationship was found between the increase in BMI and the duration of discharge. The absence of morbidly obese patients in the study may explain why BMI was not an effective factor in prolonged discharge time.

The increase in operation time with age may be related to PPCs that may develop (21, 22). Comorbid conditions may also increase with increasing age. Additionally, the prolonged operation time may cause problems in both anesthesia and surgery therefore it may affect the duration of hospitalization. In our study, age and duration of operation prolonged the duration of chest tube withdrawal and therefore the duration of discharge from the hospital. Prolonged time can be limited by preoperative comprehensive evaluation of age-related comorbid conditions and keeping the operation time as short as possible.

There are some limitations to this study. First of all, the study is a single-center and retrospective study. Additionally, long-term complications of the patients after surgery could not be evaluated.

CONCLUSION

While the prolonged chest tube withdrawal time was directly related to the longer discharge time, the VAS scores have no significant correlation with the discharge time and the chest tube removal time. Additionally, age and operation time were also found to be associated with prolonged discharge time. Prospective comprehensive studies on this subject will be useful in clarifying the factors affecting the discharge time after thoracic surgery.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was initiated with the approval of the Ankara Training and Research Hospital Ethics Committee (Date: 11.01.2022, Decision No: 2012-KEAK-15/2448).

Informed Consent: All patients were informed about the application and their informed consent was obtained.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

REFERENCES

1. Sun K, Liu D, Chen J, et al. Moderate-severe postoperative pain in patients undergoing video-assisted thoracoscopic surgery: A retrospective study. Sci Rep. 2020; 10: 795.
2. Marshall K, McLaughlin K. Pain Management in Thoracic Surgery. Thorac Surg Clin. 2020; 30: 339-46.
3. Liu X, Song T, Xu HY, Chen X, Yin P, Zhang J. The serratus anterior plane block for analgesia after thoracic surgery: A meta-analysis of randomized controlled tri. Medicine. 2020; 99: e20286.
4. Razi SS, Stephens-McDonnough JA, Haq S, et al. Significant reduction of postoperative pain and opioid analgesics requirement with an Enhanced Recovery After Thoracic Surgery protocol. J Thorac Cardiovasc Surg. 2021; 161: 1689-701.

5. Zengin M, Baldemir R, Ulger G, Sazak H, Alagoz A. Postoperative Analgesic Efficacy of Thoracic Paravertebral Block and Erector Spinae Plane Block Combination in Video-Assisted Thoracic Surgery. Cureus. 2021; 13: e15614-e.
6. Luketich JD, Land SR, Sullivan EA, et al. Thoracic Epidural Versus Intercostal Nerve Catheter Plus Patient-Controlled Analgesia: A Randomized Study. Ann Thorac Surg. 2005; 79: 1845-50.
7. Aydın G, Gençay I, Çolak S, Günal N, Özpolat B. Toraks cerrahisinde ultrasonografi eşliğinde yapılan preemptif torakal paravertebral bloğun etkinliği. Turk J Clin Lab. 2017; 8: 160-7.
8. Nagaraja PS, Ragavendran S, Singh NG, et al. Comparison of continuous thoracic epidural analgesia with bilateral erector spinae plane block for perioperative pain management in cardiac surgery. Ann Card Anaesth. 2018; 21: 323-7.
9. Practice Guidelines for Acute Pain Management in the Perioperative Setting: An Updated Report by the American Society of Anesthesiologists Task Force on Acute Pain Management. Anesthesiology. 2012; 116: 248-73.
10. Zengin M, Baldemir R, Ülger G, Sazak H, Alagöz A. Comparison of thoracic epidural analgesia and thoracic paravertebral block in pain management after thoracotomy. Anatolian Curr Med J. 2022; 4: 70-5.
11. Khalil AE, Abdallah NM, Bashandy GM, Kaddah TAH. Ultrasound-Guided Serratus Anterior Plane Block Versus Thoracic Epidural Analgesia for Thoracotomy Pain. J Cardiothorac Vasc Anesth. 2017; 31: 152-8.
12. Miniksar ÖH, Katar MK. Acute postoperative pain and opioid consumption after laparoscopic cholecystectomy is associated with body mass index: a retrospective observational single-center study. J Health Sci Med. 2022; 5: 1-6.
13. Bisgaard T, Klarskov B, Rosenberg J, Kehlet H. Characteristics and prediction of early pain after laparoscopic cholecystectomy. Pain. 2001; 90: 261-9.
14. Kara KA, Caner T. Comparison of pain in the early post-operative period using VAS score in patients after cardiac surgery who had minimally invasive incisions vs. full median sternotomy. Ann Ital Chir. 2019; 90: 3-9.
15. Markham T, Wegner R, Hernandez N, et al. Assessment of a multimodal analgesia protocol to allow the implementation of enhanced recovery after cardiac surgery: Retrospective analysis of patient outcomes. J Clin Anesth. 2019; 54: 76-80.
16. Güven BB, Ertürk T, Ersoy A. Postoperative analgesic effectiveness of bilateral erector spinae plane block for adult cardiac surgery: a randomized controlled trial. J Health Sci Med. 2022; 5: 150-5.
17. Batchelor TJP, Rasburn NJ, Abdelnour-Berchtold E, et al. Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS). Eur J Cardiothorac Surg. 2019; 55: 91-115.
18. Asban A, Xie R, Abraham P, Kirklin JK, Donahue J, Wei B. Reasons for extended length of stay following chest tube removal in general thoracic surgical patients. J Thorac Dis. 2020; 12: 5700-8.
19. Cerfolio RJ, Bryant AS, Skylizard L, Minnich DJ. Optimal technique for the removal of chest tubes after pulmonary resection. J Thorac Cardiovasc Surg. 2013; 145: 1535-9.
20. Cerfolio RJ, Bryant AS. Results of a prospective algorithm to remove chest tubes after pulmonary resection with high output. J Thorac Cardiovasc Surg. 2008; 135: 269-73.
21. Miskovic A, Lumb AB. Postoperative pulmonary complications. Br J Anaesth. 2017; 118: 317-34.
22. Canet J, Gallart L, Gomar C, et al. Prediction of Postoperative Pulmonary Complications in a Population-based Surgical Cohort. Anesthesiology. 2010; 113: 1338-50.